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## ERRATA

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Page 6 line 24 for " if " read " it "

- „ 64 24 lines from end for " methyl chloride " read " methylene chloride "
- „ 71 7 and 4 lines from end, page 72 lines 1, 2, 11 and 23 for  
" diphenylene " read " diphenylene "
- „ 81 lines 14 and 31 for " piperonyl cyclohexanone " read " piperonyl  
cyclohexenone "
- „ 120 4 lines from end for " Granovzky " read " Granovsky "
- „ 153 line 24 for " *masoni* " read " *masoni* "
- „ 170 line 9 for " Trembly " read " Trembley "
- „ 202 line 19 for " trial " read " trail "
- „ 210 line 26 for " *A. hebraeum* " read " *Amblyomma hebraeum* "
- „ 240 line 5 insert " [See *R.A.E.*, A **37** 480] " after " 1947 "
- „ 240 line 12 insert " [See *R.A.E.*, A **37** 481] " after " refs. "

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## REVIEW

OF

## APPLIED ENTOMOLOGY.

SERIES B.

Vol. 37.

1949.

GRAHAM (N. P. H.), JOHNSTONE (I. L.) & RICHES (J. H.). **Studies on Fly Strike in Merino Sheep. No. 7. The Effect of Tail-length on Susceptibility to Fly Strike in Ewes.**—*Aust. vet. J.* **23** pp. 31–37, 7 refs. Sydney, 1947.

GRAHAM (N. P. H.) & JOHNSTONE (I. L.). **No. 8. A Surgical Operation for the Control of Tail Strike.**—*T.c.* pp. 59–65, 10 figs., 5 refs.

In the first of these two parts of a series on infestation of Merino sheep by blowflies in Australia [*cf.* *R.A.E.*, B **27** 197; **28** 103; **29** 142; **30** 139], descriptions are given of five large-scale experiments designed to provide further information on the effect of tail-length on the susceptibility of ewes to blowfly-strike and to discover the length that could best replace the ill-defined 4-inch tail to render the ewes relatively insusceptible [*cf.* **30** 54; **31** 29; **32** 142]. The trials involved some 9,000 sheep and were carried out from 1943 to 1945 on two properties in south-western Queensland and three in New South Wales. Four of the five lots of sheep were Merinos. The procedure is described. The tails of lambs in each test were docked at four different lengths with reference to the vulva: not extending below the upper commissure (short), opposite the orifice (medium), just below the tip (medium-long) and  $\frac{1}{2}$  inch below the lower margin of the bare area or  $3\frac{3}{4}$  ins. in length (long). Uniform length could not be achieved. The groups merged into one another, but the relative positions of the tip of the tail and the tip of the vulva appeared to remain fairly constant throughout life.

Crutch and tail wound strikes in one test decreased with increasing length of tail from 160 per 100 sheep in ewes with short tails to 77 in those with medium-long and long tails. The numbers of strikes in tail wounds in some 500 wether lambs included in this test were 21, 7 and 4 per 100 in those with short, medium and medium-long tails [*cf.* **29** 51]. In Merino ewe lambs that had not undergone Mules' operation, the percentages showing crutch, tail and mixed strikes decreased from 42 and 41.6, in those with short tails in two of the tests to 31 and 17.4 in those with medium tails, 17 and 16.4 in those with medium-long tails and 11 and 6.7 in those with long tails. The same tendency could be seen in crutch and tail strikes taken separately. In two groups of ewes that had undergone Mules' operation in its modified form [**32** 142], percentage total strikes fell from 16.4 and 31.1 for short tails to 3.9 and 18.7 for medium tails, 1.7 and 8.8 for medium-long tails and 2.2 and 11.6 for long tails. Urine staining on tail and crutch decreased with an increase in tail length up to medium-long, then increased from medium-long to long. The only disadvantage

noticed in both medium-long and long tails was an increased tendency to dagginess that would have to be considered where dagginess is likely to be prevalent. It is concluded that tails reaching to  $\frac{1}{2}$  inch below the tip of the vulva were most satisfactory.

In the second paper, experiments are described on stretching the bare skin from the ventral surface of the tail by removing wool-bearing skin from the dorsal surface in order to lessen the incidence of tail strike [*cf.* 36 118]. The virtual elimination of crutch strike by Mules' operation in the modified form has made tail strike more apparent. In short-tailed sheep, strike tends to start on the tip of the tail on account of urine staining of the wool there. In long-tailed sheep, it usually starts on the side of the tail towards the tip because the wool on the ventral surface becomes stained from contact with the vulva. Often this wool is growing on the lateral surface of skin folds at the sides of the tail. Preliminary tests showed that removing a single strip of skin down the mid-line of the dorsal surface of the tail, a strip of woolled skin down each side of the tail, or a U-shaped strip down the sides and across the end of the tail all gave good results, the first being most convenient for longer tails and the last for shorter tails. The first method was used in subsequent trials on sheep with medium-long tails. In the first ones, too little skin was removed. The technique eventually developed on sheep with such tails was to remove all skin from the dorsal surface of the tail except for a narrow strip at each side, about  $\frac{1}{2}$ -inch wide at the butt and tapering away to nothing at the tip. The strips of skin removed varied from 1.5-4 ins. wide. The excision was started just above the butt of the tail. When the sheep used in one trial were examined after 20 months, wool was present on the under-side of the tail in 11 per cent. of the controls and 2 per cent. of the treated sheep. The bare skin extended partly up the sides of the tail in 9 and 61 per cent. in the two groups, respectively. Appreciable amounts of wool were left at shearing on 53 per cent. of the controls and only 16 per cent. of the treated sheep. No tail strikes occurred in sheep treated by this technique. The low incidence of strike in the control groups largely due to Mules' operation and the medium-long tails made evaluation difficult, but the freedom of the sides and tip of treated tails from wool and urine staining indicate that the operation should greatly reduce the incidence of tail strikes. It is concluded that tail strikes could be practically eliminated by docking lambs so that their tails are medium-long, carrying out Mules' operation in its modified form, and using the tail operation on sheep in which wool-bearing skin encroaches upon the ventral surface of the tail. Routine use of the tail operation on all sheep is considered unnecessary. In one test on sheep with short-tails, a segment of skin about 3 ins. wide and 2 ins. in the antero-posterior direction was excised, the posterior border of the excision coinciding with the junction of the wool-bearing and wool-free skin on the tail stump. When cicatrisation was complete the bare skin extended about half an inch anteriorly on the dorsal surface. It is thought that such a technique would be effective when, for any reason, sheep have been docked with short tails.

SHANAHAN (G. J.) & MORLEY (F. H. W.). **Jetting with B.H.C. Experiments at Trangie and Bellata.**—*Agric. Gaz. N.S.W.* 59 pt. 5 pp. 271-273, 4 refs. Sydney, 1948.

Experience in the prevention of infestation of sheep by blowflies in New South Wales has shown that the modified Mules' operation [*R.A.E.*, B 32 142] and tail operation [*cf.* preceding abstract] practically eliminate breech strike in Merino ewes in most years, but that the additional protection afforded by crutching, jetting or both is required in seasons in which the flies are unusually abundant. In the autumn of 1937, BHC (benzene hexachloride) was tested as an alternative to calcium arsenite for jetting against breech strike. A group

of 679 ewes of mixed ages at Trangie and one of 1,090 maiden ewes at Bellata, containing approximately equal numbers of sheep of types A, B and C [28 103] were divided into three lots and jetted, about five weeks from crutching, with 1.0 per cent. calcium arsenite, or 0.3 or 0.5 per cent. BHC in emulsified solution, respectively. The emulsion was prepared by dissolving the BHC containing 13 per cent.  $\gamma$  isomer in xylene and adding a suitable emulsifier. The sheep in both experiments were grazed together. Results are shown in a table. At Trangie, there were less strikes in the sheep treated with BHC; after 35 days the strikes in the groups receiving the three treatments totalled 8.8, 5.4 and 7.9 per cent., respectively. At Bellata, calcium arsenite was somewhat more effective than BHC for the 31 days of the trial, the final totals being 4.9, 8.5 and 5.6 per cent., respectively. The differences were not statistically significant in either case. Like calcium arsenite, BHC appeared to be effective in preventing such strikes as occurred from developing to any important extent and in other tests in which already infested ewes were jetted with it at either concentration, it usually caused the larvae to leave the strike within 30 minutes. It had no apparent adverse effect on the ewes.

SHANAHAN (G. J.) & MORLEY (F. H. W.). **Poll Strike in Rams. B.H.C. as a Preventive. Further Trials at Nyngan and Trangie.**—*Agric. Gaz. N.S.W.* 59 pt. 5 pp. 263–264, 2 refs. Sydney, 1948.

An account is given of four further experiments in New South Wales in which BHC (benzene hexachloride), containing 13 per cent.  $\gamma$  isomer, was used to protect Merino rams from poll strike by blowflies [*cf. R.A.E.*, B 36 57]. Each treated group was put to graze with a group of untreated rams. Blowflies were unusually abundant during the trials. Two lots each consisting of 87 rams, shorn in August, 1947, were jetted on the poll during September, using power-jetting plant. Those of one lot were treated with 1 per cent. BHC as a suspension of a dispersible powder applied from a two-jet nozzle at a pressure of 30–40 lb. per sq. in. and a rate of 3.6 pints per ram. The wool on the poll was completely wetted. The other lot received 0.75 per cent. BHC in emulsified xylene solution [*cf. loc. cit.*] at the rate of 1 pint per ram and a variable pressure of not less than 40 lb. The nozzle was thrust into the wool behind each horn and given two momentary squirts. The polls of 66 rams, shorn five months previously, were jetted in September with 1.0 per cent. BHC in emulsified solution applied with a stirrup pump, and a 1.0 per cent. suspension was tested in October on 98 rams shorn about six months previously, using a hand-jetting plant. The last two sprays were applied at 2 pints per ram. The percentages of poll strike after 56 days in treated and (in brackets) untreated rams in the first three tests were 8.5 (40.7), 12.6 (42.5) and 7.6 (93.9), respectively. The remaining trial was terminated after 26 days, with a poll strike of 0 and 37.5 per cent. in treated and untreated rams, respectively. The differences in each case were statistically significant. The results of the second test, in which an attempt was made to increase the speed of operation, indicated that the wool was insufficiently wetted. It is concluded that 1 gal. of 1.0 per cent. BHC, either as a suspension or an emulsified solution, will protect at least four rams for eight weeks, provided that care is taken to saturate the wool immediately behind the horns. It is recommended that as much wool as possible be left in the affected areas to retain the insecticide and thus prevent restrike [*cf. 36 153*].

**Chorioptic Mange in Cattle.**—*Agric. Gaz. N.S.W.* 59 pt. 5 p. 270. Sydney, 1948.

*Chorioptes bovis*, Gerl., has recently occurred on cattle in a stud herd in New South Wales, on which it was controlled by means of lime-sulphur; as it is probably widespread in the State, a brief account is given of the symptoms

and treatment of the mange it causes, which is usually limited to a small area and is rarely severe. Control is effected by clipping the hair from the area of the lesion, scrubbing with hot soapy water and applying lime-sulphur solution containing 1.0 per cent. polysulphides as a spray or by scrubbing, the treatment being repeated three times a week.

VANDERPLANK (F. L.). **Experiments in the Hybridisation of Tsetse-flies (*Glossina*, *Diptera*) and the Possibility of a new Method of Control.**—*Trans. R. ent. Soc. Lond.* **98** pt. 1 pp. 1–18, 2 pls., 12 refs. London, 1947.

This paper contains a detailed description of the methods employed and the results obtained in experiments, already noticed from a briefer account [cf. *R.A.E.*, B **34** 36], in which it was shown that *Glossina pallidipes*, Aust., mated only reluctantly with *G. morsitans*, Westw., and *G. swynnertoni*, Aust., but the latter mated readily with each other and produced hybrid offspring, though the hybrid males were sterile and the females at least partly so. The appearance of the hybrids is described, and the male genitalia of the species and hybrids are figured.

A sample of 51 male *Glossina* from the Chungai fly area in Tanganyika, in which the belts of *G. morsitans* and *G. swynnertoni* overlap, included one that was evidently a hybrid of the two species and 20 that were atypical *morsitans* or *swynnertoni* and might have resulted from back crossing of hybrids with pure-bred flies, if this occurs. In a further sample of 99 males from the Babati area, in which *G. morsitans*, *G. swynnertoni* and *G. pallidipes* overlap, one was evidently a *pallidipes* hybrid and one male of *G. morsitans* was slightly atypical. The two areas are described in an appendix by W. H. Potts.

In the experiment in which C. H. N. Jackson released *G. morsitans* in *swynnertoni* country at Shinyanga [cf. *loc. cit.*], 14 non teneral females were recovered after release and kept in the laboratory, where 12 lived long enough to reproduce. From the progeny produced, it was concluded that one had mated with its own species and one apparently with both, while seven failed to reproduce and three produced hybrids. Of two non-teneral females of *G. morsitans*, evidently of the first filial generation, caught two months later near the site of release, one died after two days, but the other survived for 90 days and gave rise to a hybrid male. These results supported the earlier laboratory finding that pairing between the two species occurs at random, a conclusion that was confirmed by Jackson's later observations [34 198], and it was further concluded that in such work, the numerically superior species would sterilise progressively more and more of the numerically inferior one.

In view of this and Jackson's finding that *G. morsitans* can survive at least in decreasing numbers and produce a second generation in the thornbush habitat of *G. swynnertoni* [34 197–198], a large-scale experiment was begun in an isolated block of *swynnertoni* country about ten square miles in area in which the population of *G. swynnertoni* had already been reduced by other measures [cf. 34 36]; 144,000 pupae of *G. morsitans* from Kondoa Irangi were introduced in July 1944, and a year later the population of *G. swynnertoni* was found to have decreased in accordance with mathematical expectation [cf. 34 51].

SMART (J.). **The British Simuliidae with Keys to the Species in the adult, pupal and larval Stages.**—*Sci. Publ. Freshwater biol. Ass. Brit. Emp.* no. 9, 57 pp., 17 figs., 25 refs. Ambleside, Westmorland, 1944.

Notes are given on the morphology in all stages, life-history and parasites of Simuliids as seen in British species, together with brief instructions for collection, preservation and examination. The larvae are often parasitised and killed by three protozoa (two species of *Thelohania* and one of *Serumsporidium*) and

a Nematode (*Mermis* sp.), all of which live in the body cavity and if well developed can be detected on examining the larva whole [cf. *R.A.E.*, B 27 249-250; 33 61].

Systems of classifying Simuliids are very briefly reviewed, the one adopted being that of F. W. Edwards [cf. 35 96], and a check-list of the British species is included, showing any synonyms used by authors who recorded them from the British Isles. Keys are given to the adults, pupae, cocoons and larval stages, and notes on the ecology and distribution of each of the 19 species are included. The keys are largely from works by Edwards and I. M. Puri.

PRUTHI (H. S.). **Studies on House-fly and other Diptera.**—*Abridg. sci. Rep. agric. Res. Inst. New Delhi 1941-44* pp. 69-70. Delhi, 1946.

Regular collections of house-flies in Delhi showed that six species of *Musca* were present, but only *M. nebulosa*, F., and *M. domestica vicina*, Macq., were abundant. Populations were greatest in August, when the weather is hot and damp, and least in January, when the lowest minimum temperatures occur. Over 90 per cent. of the flies round human dwellings bred in dung and garbage. *M. nebulosa* and *M. d. vicina* seemed to prefer cow-dung and household refuse to horse-dung, which develops a temperature of 122°F. in about 4-7 days and becomes unsuitable for development. A control method was developed in which all the daily refuse of dung and litter was put into a pit made to take a week's supply. At the end of the week the pit was sealed with earth applied in three successive four-inch layers, each of which was well pressed down and had the top two inches watered and plastered down. By this means, all larvae were killed in six hours. It was effective even in wet weather, so long as the earth used for covering the pit was not oozing wet. The buried dung formed excellent manure, and the process was cheaper and more effective than the previous method of putting the dung into a pit daily and covering the top with a six-inch layer of earth [cf. also *R.A.E.*, B 35 33], which allowed many flies to emerge. Larvae were also destroyed by spreading fresh cow-dung in the sun in layers up to two inches thick. No oviposition took place and any larvae already present died in less than three days.

**Peet-Grady Method.** **Official Method of the National Association of Insecticide and Disinfectant Manufacturers for evaluating liquid Household Insecticides.**—*Soap & sanit. Chem. Blue Book 1944* pp. 201-204. New York, N.Y., 1944.

The Peet-Grady method of testing fly-sprays [*R.A.E.*, B 16 255] was adopted as the official method of the National Association of Insecticide and Disinfectant Manufacturers in the United States in 1932 and various improvements in detail have since been officially accepted [cf. 27 22-23]. Two procedures are now allowed. These are the small-group procedure, which is substantially the same as that outlined when the test was adopted in 1932 and in which lots of 100 flies (*Musca domestica*, L.) with natural sex ratios isolated in the pupal or adult stage are used, and the large-group procedure, which was officially adopted in 1938 and is made with lots of 500 flies with uniform sex ratios isolated in the pupal stage [cf. 26 245]. In both methods, liquid contact insecticides used as sprays are evaluated by comparison with the Official Test Insecticide (O.T.I.) [cf. 27 23].

Apparatus, procedure and conditions for official valuation are described. The rearing room is kept at a temperature of 80-85°F. and a relative humidity of 40-70 per cent., and the testing room during tests at 75-85°F. Cages should provide at least 1 cu. inch space per fly and preferably have a detachable floor. At least two sides and the top must be screened. The testing chamber is a cube with sides 6 ft. long measured internally. The inner surface must be smooth

and impervious to insecticides and free from cracks and projections. There must be a tight-fitting door, large enough for a man to enter, and at least one observation window. Illumination is provided by any suitable means. Ventilation after each test is effected by an exhaust fan moving not less than 1,000 cu. ft. air per minute, and is made possible by an air duct covered with wire screen and suitably placed ventilation openings. Openings for the introduction of the insecticide must allow of uniform distribution. The atomiser is a special one constructed by the DeVilbiss Company and is operated at a pressure of  $12.5 \pm 0.5$  lb. per sq. in. [cf. 35 133-134] and must deliver 12 cc. base oil in  $24 \pm 1$  sec. Tests are carried out on batches of flies having an average age of not less than 4 nor more than 6 days and containing individuals not less than 3 nor more than 7 days old, and of such susceptibility that the mortality caused by the O.T.I. is 30-55 per cent.

Only flies that show no sign of life upon being touched may be counted as dead [cf. 28 203]. Batches showing a natural mortality greater than 5 per cent. on the day appointed for testing may not be used. In interpreting results, a kill of +16 or higher (16 per cent. higher than the O.T.I.) is rated as Grade AA (excellent), one of +6 to +15 as Grade A (good) and one of -5 to +5 as Grade B (equal to O.T.I.) [cf. 27 23-24]. In the small-group procedure, not more than two unknowns may be tested in conjunction with one O.T.I. in any one series. Ten tests are made of the O.T.I. and each unknown in parallel. The standard error of the mean difference between the average kill effected by the O.T.I. and the average effected by the unknown must be less than 3. If it exceeds 3, additional paired tests must be made until it falls below this figure. In the large-group procedure, evaluation is based on the difference in kill effected by the O.T.I. and the unknown as determined by one comparison on each of three cultures. Each culture used in determining the evaluation must show a mortality of 30-55 per cent. when sprayed with the O.T.I. Replicated O.T.I. tests on one culture must agree within 10 points. Examples of the method of assembling the data and calculating the results are given for each procedure.

**WATERHOUSE (D. F.). An Examination of the Peet-Grady Method for the Evaluation of Household Fly Sprays.**—*Bull. Coun. sci. industr. Res. Aust.* no. 216, 24 pp., 1 graph, 18 refs. Melbourne, 1947.

The large-group Peet-Grady method [cf. *R.A.E.*, B 26 245] has been used in Australia of recent years to evaluate household fly-sprays, but has been found to possess several disadvantages for this purpose. These are discussed with reference to tests in which house-flies (*Musca domestica*, L.) were exposed to sprays of 0.13 per cent. pyrethrins, 3.5 per cent. Thanite (bornyl thiocyanacetate) [cf. 36 166] or 5 per cent. Lethane 384 (50 per cent.  $\beta$ -butoxy- $\beta'$ -thiocyanodiethyl ether) in comparison with the Official Test Insecticide (about 0.1 per cent. pyrethrins). It is pointed out that the standard dosage of 12 ml. in a chamber 216 cu. ft. in volume is far higher than that normally used in actual practice; it resulted in much higher knockdown and mortality for all three materials than one of 2 ml. (1 fl. oz. per 3,000 cu. ft.), whereas, except for Lethane, the latter dosage gave comparable results in the chamber and in a room (2,000 cu. ft.). If this dosage were adopted for standard tests, a second, more concentrated standard insecticide would be required, and a comparative test showed that 0.5 per cent. pyrethrins at 2 ml. in the chamber gave practically the same mortality as the O.T.I. at 12 ml. The knockdown, however, was lower (80 per cent. in ten minutes as compared with 95 for the O.T.I.), and methods of overcoming this practical difficulty are discussed.

It is desirable for actual use that a fly-spray should give a high knockdown in five minutes or less; in tests with the Peet-Grady chamber, a reduction in exposure time from ten minutes to one caused reductions in knockdown for

all three materials, but they were not large. Further reductions were caused by introducing the sprays with the exhaust fan running, but natural conditions as severe as this are seldom encountered.

Various methods of increasing the intrinsic accuracy of the test, including precautions to ensure uniformity of sex ratio in the batches of flies [26 244-245] and uniformity of dosage [28 238], are discussed from the literature. Uniformity of flies in various cages of the same batch, uniformity of spraying pressure and spraying procedure, and the validity of using a standard reference insecticide were examined to evaluate their influence on the variability of results obtained by the Peet-Grady method. The variation in activity and distribution of flies in the chamber from test to test was considered to be the most probable explanation for the fact that the amount of insecticide received by different individuals varied greatly. Variations in spray distribution from test to test may also be a contributing factor. Although the variability in results is reduced by a reduction in chamber size, this reduction favours any fumigating effect and renders flight conditions less like those in actual practice. Difficulties that arise in any method of testing fly-sprays are the variation in susceptibility of laboratory-reared and wild flies and the classing of moribund flies as alive or dead.

The probable future use of the Peet-Grady method is discussed. It was evolved essentially for comparison of insecticides that act in a manner similar to pyrethrins and is not particularly suited for rating sprays containing DDT, which is relatively slow in action. Most fly-sprays will now be based on a combination of DDT with a component giving rapid knockdown, and the killing power of such a spray would be more conveniently ascertained by a chemical assay of the DDT than by a biological test, though the latter would still be required to assess knockdown. Furthermore, household sprays in Australia are used quite as much against mosquitos, blowflies and silverfish as against house-flies, and even an improved test on the latter will give no reliable information as to toxicity to the former.

**A modified Mosquito Light Trap.**—*Bull. U.S. Army med. Dep.* 5 no. 1 p. 13, 1 fig. Washington, D.C., 1946.

The standard in the New Jersey mosquito light-trap [*cf. R.A.E.*, B 31 195] has to be practically dismantled if the lamp has to be replaced. This difficulty has been avoided by slightly increasing the size and diameter of the conical roof [23 151] and closing an opening in the top by a removable cover, locked in place by means of slide clips, to which the lamp socket is soldered. The method of fixing the bottom of the wire-screen funnel to the jar cap that holds the collecting jar is also specified to avoid the formation of a shelf and so ensure that all mosquitos that enter the trap fall into the collecting jar.

**Effect of Water Purification on Removal of DDT.**—*Bull. U.S. Army med. Dep.* 5 no. 1 p. 14. Washington, D.C., 1946.

Experiments in Atlanta, Georgia, showed that the standard methods of water purification, including coagulation, the use of activated carbon and filtration, would remove practically all DDT from a water supply. The iron salts were slightly more effective than alum as coagulants. Activated carbon was most effective when added after the floc was removed. Contact for 30 minutes was enough if the carbon had been thoroughly mixed with the water, and except with a high content of DDT, two parts of activated carbon per million appeared sufficient. The small residual portions of DDT remaining after coagulation and filtration were removed by storage for 4-5 days, or by filtration through cation and anion zeolites.

**Fly Control with DDT.**—*Bull. U.S. Army med. Dep.* **5** no. 1 pp. 22–23. Washington, D.C., 1946.

Four possible methods of applying a 5 per cent. DDT solution to the fly screens of the 240 mess halls of a military camp in Georgia were compared in 1945, namely, painting, dipping, and spraying with pressure sprayers with or without the use of backing behind the screens. Microscopic examination of the crystals of DDT formed after three days showed that painting produced both longer individual crystals and thicker clusters of crystals. Painting with wide-shouldered brushes required less time and labour than the other treatments, except spraying without backing and, in view of the high toxicity of crystalline residues [*cf. R.A.E.*, B **34** 122], it was chosen as the best method. The mess halls of the entire camp could be treated in a week, and this was done in May, July and September. Garbage racks were sprayed monthly [*cf. 35* 40], the process occupying three days. As a result of these measures, flies were seldom seen inside the mess halls.

**New DDT Applicators for Screens.**—*Bull. U.S. Army med. Dep.* **5** no. 5 pp. 502–503, 2 figs. Washington, D.C., 1946.

Descriptions are given of two applicators designed to replace paint-brushes and hand sprayers for applying a 5 per cent. solution of DDT in kerosene to the window screens of military camps. In one, the solution is held in a rectangular container on the end of an adjustable pole and fed through small holes into a strip of wool-felt fixed in a slot; the other consists of a wooden roller covered with a piece of thick carpet material, which can be saturated with the solution by dipping in a trough. A modification of this device is a carpet-covered metal cylinder filled with the solution, which escapes through a row of feed holes. The wool-felt applicator was preferred.

GJULLIN (C. M.) & YATES (W. W.). *Anopheles and Malaria in the north-western States.*—*Mosq. News* **5** no. 4 pp. 121–127, 3 figs., 5 refs. New Brunswick, N.J., 1945.

Malaria was an important disease in Oregon and Washington in the 19th century. It is still endemic in the Willamette Valley, in western Oregon, but there have been few recent cases in eastern Oregon or in Washington or Idaho. There was a danger, however, that it might be re-introduced by returning Army personnel or prisoners of war employed on the land and possibly aggravated by proposed irrigation schemes, and the authors therefore review present knowledge of the distribution and abundance of *Anopheles* spp. in the area, based on the literature [*cf. R.A.E.*, B **23** 285] and on collections of larvae and adults made since 1936, detailed records of which are given. *Anopheles maculipennis* var. *freeborni*, Aitken, *A. m. occidentalis*, D. & K., and *A. punctipennis*, Say, were taken in all these States, and *A. pseudopunctipennis franciscanus*, McCracken, was recorded for the first time in Oregon, where larvae were found in 1944 near the mouth of the Pistol River. Trap collections showed that Anophelines were more numerous in the Yakima Valley in Washington than in the Willamette Valley; *A. m. freeborni* was the predominating species in the former, and *A. punctipennis* in the latter. In spite of the prevalence of *A. m. freeborni*, which is known to be an important vector, and a yearly influx of harvesters, the relatively few cases of malaria that occur in the Yakima Valley lead the authors to conclude that the disease is less likely to become a problem in newly irrigated areas in western Washington than in the Willamette Valley, where irrigation schemes are also proposed. The places for which these projects are planned, the distribution of malaria in 1935–44 in Oregon and that of the four Anophelines in all three States are shown on maps.

REES (D. M.). **Notes on Mosquito Migration in Salt Lake City in 1945.**—*Mosq. News* 5 no. 4 p. 134. New Brunswick, N.J., 1945.

Large numbers of *Aedes dorsalis*, Mg., migrated into Salt Lake City, Utah, on 22nd June 1945 and remained there until 9th July. They originated in extensive temporary breeding places in the marshes two miles or more to the west. The atmospheric conditions favoured migration, and there was a clear full moon when it occurred. Seven other major migrations of this sort from west to east have been observed since 1931, and all took place at the time of a full moon, although general dispersals or minor migrations have occurred in the area at other times.

HOLDSWORTH jr. (R. P.), DEONIER (C. C.) & HARRISON (Z. D.). **DDT Emulsion for the Control of Culicine Mosquitoes in Cisterns.**—*Mosq. News* 5 no. 4 pp. 144–145. New Brunswick, N.J., 1945.

In Key West, Florida, mosquitos, especially *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and *Aedes aegypti*, L., breed abundantly in abandoned concrete rainwater cisterns, and DDT at various concentrations was tested against the larvae in 31 of them between November 1943 and July 1944 by mixing a concentrate containing 20 per cent. DDT, 60 per cent. xylene and 20 per cent. Triton X-100 with the water. The results varied considerably as some of the cisterns were open and the others covered, while some were full of rubbish and a few were highly polluted, necessitating treatment at a higher rate for the same effect. Females continued to oviposit in the treated water, but the larvae died on hatching. In general, a single treatment at 5 parts DDT per million prevented the appearance of fourth-instar larvae throughout the experiment (37 weeks), 0.1 p.p.m. for 13 weeks, and 0.05 p.p.m. for up to 5 weeks; 0.025 p.p.m. gave initial kill only.

WELCH (E. V.). **The Finding of *Anopheles albimanus* Wied. at West Palm Beach, Florida (Diptera Culicidae).**—*Mosq. News* 5 no. 4 p. 145. New Brunswick, N.J., 1945.

During a routine Anopheline inspection at West Palm Beach, Florida, in August 1943, a single dead female of *Anopheles albimanus*, Wied., was found near an airport, hanging in a spider's web beneath a bridge over a canal. Since this species is not native to Florida, and subsequent inspections of the area have failed to reveal additional examples, it is presumed to have been a chance importation.

**Malaria Control on impounded Water.**—9½×6 ins., xiii+422 pp., 215 figs. (21 col.). Washington, D.C., U.S. publ. Hlth Serv. & Tennessee Valley Auth., 1947. (From Supt. Documents.)

This book was prepared jointly by members of the Health and Safety Department of the Tennessee Valley Authority and the malaria control headquarters of the United States Public Health Service. Its purpose is to set out information on the basic principles and modern practice of Anopheline control on impounded waters as an anti-malaria measure, so arranged that it may provide a work of reference for engineers, medical officers and others concerned with this work [*cf.* *R.A.E.*, B 33 134; 36 2, etc.]. Introductory chapters are concerned with a brief survey of the nature and distribution of malaria, the conditions under which it occurs, its vectors in the United States, its effect on development and its relationship to reservoirs, and with the planning of control, the choice of appropriate measures, and the integration of these

measures with the planning, construction and operation of a reservoir. Discussions follow on the preparation of the reservoir basin by clearing and marginal drainage to ensure a clean water surface and shore line; permanent measures to prevent breeding at the margins [33 124], including impoundage of lateral tributaries; water-level management; shore-line maintenance; application of Anopheline larvicides and of DDT sprays and aerosols against the adults in their daytime resting places; mosquito-proofing of houses and spraying them with DDT to leave a toxic residue; the facilities required, field procedure used and reports to be made; the relation of plants to Anopheline control; the interrelations of Anopheline control and wildlife conservation; and the training of personnel and maintenance of proper public relations. The adaptation of the various measures to small reservoirs is dealt with somewhat briefly.

Information is also given on the morphology and biology of the species of *Anopheles* occurring in the United States and on the characteristics and epidemiology of malaria and the making of mosquito and malaria surveys. A list of the more important species of *Anopheles* transmitting malaria in all parts of the world, showing typical breeding places and usually applicable control measures, is given in an appendix, and others contain a summary of State legislation pertaining to Anopheline control on impounded water and information on equipment, procedure and technique.

BOHART (R. M.). **A Synopsis of the Philippine Mosquitoes.**—Navmed no. 580, [1+]<sup>+</sup>88 pp., 10 pls., 33 refs., multigraph. [Washington, D.C.] Dep. Navy, Bur. Med. Surg. [1945.]

This paper contains keys to the mosquitos found in the Philippine Islands, together with notes on the morphology and distribution of most of them, the synonymy of some and the breeding place where known. Tables are included showing the Philippine species of *Anopheles* that have been incriminated as natural or experimental vectors of malaria.

SCHLOSSER (R. J.). **Observations on the Incidence of *Wuchereria bancrofti* Larvae in the native Population of the Solomon Islands Area.**—*Amer. J. trop. Med.* **25** no. 6 pp. 493-495. Baltimore, Ind., 1945.

Examination of thick blood films from 1,741 natives of Guadalcanal, Malaita and San Cristobal in the Solomon Islands and of Fiji and the Gilbert Islands showed the presence of microfilariae of *Filaria (Wuchereria) bancrofti* in 10.2, 10.2, 31.5, 19.8 and 16.3 per cent., respectively. There was evidence of nocturnal periodicity, which was marked for the Solomons and less so for the Gilbert Islands. Further tests showed that the total incidence determined by two methods (thick smear and measured volume of blood) was higher than that determined by either method alone. Of 238 females of *Anopheles punctulatus*, Dön., and 24 of *A. farauti*, Lav., fed at 7.30 p.m. on an infected native from the Gilbert Islands, 17 and 4, respectively, picked up the filaria larvae, but these failed to survive more than 36 hours in the former though they developed for four days in the latter. It was not possible to complete the experiment owing to the small number of females of *A. farauti* available, but it has been shown that larvae of *F. bancrofti* will readily develop to infectivity in this mosquito [*cf. R.A.E.*, B **34** 123].

REY (H.), SOTO (H.) & HUFFAKER (C. B.). ***Anopheles punctimacula* D. & K. as the Vector of Malaria in Medellín, Colombia, South America.**—*Amer. J. trop. Med.* **25** no. 6 pp. 501-505, 24 refs. Baltimore, Md., 1945.

In a survey of 3,377 samples of blood and 3,005 spleens in the Medellín-Itagüí area of Antioquia, Colombia, at an altitude of over 5,000 ft., 8 and 11

per cent. of the blood samples from school children and persons of all age groups examined in their homes, respectively, were positive, and 26 and 30 per cent. of the spleens in the same groups were enlarged. *Plasmodium vivax* was the only parasite found in significant numbers, but *P. falciparum* occurred in a few samples.

*Anopheles argyritarsis*, R.-D., *A. pseudopunctipennis*, Theo., *A. eiseni*, Coq., and *A. punctimacula*, D. & K., were the only species of *Anopheles* found in the area during 16 months of study of breeding places and of adult populations in dwellings, stables and Magoon traps [R.A.E., B 23 302]. Their relative abundance and their breeding places are discussed. *A. punctimacula* represented over 96 per cent. of the adults and 98 per cent. of those taken in human habitations [cf. 34 148], and a stomach infection was found in one female of this species among 177 examined. Its importance as a vector elsewhere is discussed from the literature, and it is concluded that it is the vector in the city of Medellín. Its larvae constituted 29 per cent. of the total collected in Medellín, where, at a temperature of about 22°C. [71·6°F.], they occurred commonly in ground pools exposed to the sun, often near dwellings. Its breeding places were very numerous throughout the expanse of the nearly treeless, broad, flat valley of the Rio Medellín, and the larvae were also found in shaded, slow-moving branch streams, the banks of which were covered with herbaceous vegetation [cf. 24 145; 30 12; 35 204]. They were largely confined to well-shaded waters in certain lowland areas in Colombia, and evidence of their occurrence in places fully exposed to the sun was seen only in the highlands. It is possible that their limitation to shaded places in hot areas may be due to the temperature.

CALDWELL (J. D.). **Malaria Control in the Dominican Republic.**—*P. R. J. publ. Hlth* 21 no. 2 pp. 193–200, 7 refs. Brattleboro, Vt., 1945. (Also in Spanish pp. 201–208.)

A brief account is given of the climate and geography of the Dominican Republic. Malaria is present throughout the country, with increases in spring and autumn, when the rainfall is heaviest. Anophelines breed mainly in streams, but also in some places in swamps, fresh-water lagoons or flood water and in irrigation ditches. The species present are *Anopheles albimanus*, Wied., which is the principal vector, *A. grabhami*, Theo., *A. vestitipennis*, D. & K., and possibly also *A. crucians*, Wied. A Malaria Division was established in 1941 and carried out restricted surveys, and a wider service was set up in 1943 and extended in 1944 in co-operation with the Institute of Inter-American affairs. This service undertook various drainage schemes in 1943–44, details of which are given. Complete malaria surveys were made in 1944 in 31 representative communities, and 36 blood and spleen surveys. Positive blood smears ranged from 0·8 to 38·0 per cent., and spleen rates, by communities, from 0 to 42·8 per cent., the medians being 7 and 6 per cent., respectively. A total of 13,546 blood smears was examined in the laboratory and 7,550 spleens in the field. Of 1,374 positive blood smears, 72·8 per cent. showed *Plasmodium falciparum*, 17·2 per cent. *P. vivax*, and 4·7 per cent. *P. malariae*, in addition to mixed infections.

LIVADAS (G. A.), BELIOS (G. D.) & ISSARIS (P. K.). **Adult Spraying with DDT. Experimental Applications.** [In Greek.]—99 pp., 2 figs., 3 maps, 5 graphs, 19 refs. Athens, Sch. Hyg., 1946. (With a Summary in English.)

Experiments were begun in Greece in the summer of 1945 to assess the value of spraying in houses and animal quarters with DDT for the control of

Anophelines and malaria. The work was carried out in a town and 33 villages situated in different districts, the spray used was 2.5 per cent. DDT in oil and the Anophelines concerned were *Anopheles maculipennis*, Mg., including var. *sacharovi*, Favr (*elutus*, Edw.), and *A. superpictus*, Grassi. Details of the work are shown in tables and graphs; the following is based on the authors' summary of the results observed up to the spring of 1946.

Notes are given on the conditions in the areas treated, including the population, housing conditions, Anopheline breeding places, prevailing Anophelines and malaria incidence, and on the technique used, and the results of the experiments are analysed from the entomological, epidemiological, technical and economic standpoints. Sprayed premises generally became free from Anophelines in a few hours and remained so for long periods, whereas untreated premises showed a fluctuating Anopheline population, depending mainly on the production of adults from breeding places and on their movements. The fact that for some days immediately after treatment there was a steady reduction in Anopheline density in untreated control stations in all the areas showed that the DDT was toxic and not merely repellent [cf. R.A.E., B 36 66]. The treatment also controlled *Culex* and sandflies (*Phlebotomus*), the duration of the effect indicating that they were about as sensitive to DDT as the Anophelines. In the Sperchios area, treated premises remained free from Muscid flies for about two months; after this period they began to reappear, in the absence of any other insect, at first in sleeping quarters and later in animal quarters, which had been sprayed more intensively, but still occurred in smaller numbers than in untreated buildings.

In the village of Zilefton (Sperchios area), the spleen index fell from 65 to 27 per cent. during the four months after spraying (June–October 1945) and was lower than the corresponding indices for the years 1934–39, although the latter had been favourably affected by measures against Anopheline larvae during that period in a neighbouring area. Furthermore, in October 1945, the spleen and malaria parasite indices in the neighbouring unsprayed village of Rodonia were 2–3 times the corresponding indices for Zilefton. In the village of Paliouri, in the same area, the indices for 1945, after spraying, dropped below the lowest for the period 1935–39. In the village of Myli (Argos–Corinth), there was a substantial and sudden drop in the incidence of malaria in the two months after spraying (September–October), and the usual rise in the indices failed to occur.

The relation between the quantity of DDT per unit surface area and the duration of its insecticidal effect was studied. Data from a group of villages in the Pamissos area were analysed statistically and are expressed on a graph from which it is concluded that the number of days of protection from adult Anophelines is equal to the number of centigrams of pure DDT used per square metre. Since the epidemic period in Greece lasts six months (May–October), the application of DDT at the rate of 1.80 gm. per sq. metre at the beginning of this period would provide sufficient protection throughout the period of malaria transmission.

Questions of labour and expense are examined, and a comparison indicates that the cost of spraying with DDT is much lower in rural areas than that of controlling the larvae by means of Paris green. A very short account is given of the results of preliminary tests in which Anopheline breeding places were sprayed with DDT from aircraft; they indicate that the treatment remains effective for some time after its application.

In the final section, spraying technique is examined in detail; the most important types of spraying equipment in use are described, the preparation of solutions is discussed, precautionary measures are indicated and general directions are given for the organisation of the work.

KAN (Huai-chieh). **Malaria Incidence in two Districts in western Chekiang, China.**—*Chin. med. J.* **62** no. 4 pp. 311–313, 1 ref. Washington, D.C. [1945.]

Descriptions are given of two hilly and somewhat isolated districts in the western part of Chekiang Province in which malaria surveys were carried out and the parasite rates were found to be 4.7 and 4.4 per cent., the predominant parasite being *Plasmodium malariae*. The presence of malaria in western Chekiang had not previously been recorded. A few Anopheline adults and larvae were taken in the first district and 35 females in the second between August 1934 and May 1936. All were *Anopheles hyrcanus* var. *sinensis*, Wied. The 35 females were dissected but were negative for oöcysts and sporozoites.

KWOH (C. S.). **A preliminary Report of Malaria Survey in Kweichow.**—*Chin. med. J.* **62** no. 4 pp. 314–319, 1 ref. Washington, D.C. [1945.]

The results are given of a malaria survey carried out in the principal districts of Kweichow Province in 1939–40. In many parts, where *Anopheles hyrcanus* var. *sinensis*, Wied., was the only Anopheline, the incidence of the disease was low, but it was higher in a few districts where other species, including *A. minimus*, Theo., and *A. maculatus*, Theo., also occurred.

CHUNG (Huei-lan). **On the Susceptibility of *Phthirus pubis* to Infection with Typhus Virus.**—*Chin. med. J.* **62** no. 4 pp. 331–333, 9 refs. Washington, D.C. [1945.]

The following is based on the author's summary. Three batches of *Phthirus pubis*, L., bred in the laboratory were fed for 7–9 days on three patients suffering from typhus in Peking, and saline suspensions of them were inoculated into guineapigs. The guineapigs showed typical febrile reactions and sometimes also scrotal swelling. *Rickettsia prowazeki* was demonstrable in scrapings as well as in tissue cultures of the inflamed tunica and in the gut of examples of *Pediculus humanus*, L., inoculated rectally with the brain emulsion of infected guineapigs. In view of the prevalence of typhus and the fairly common occurrence of *Phthirus pubis* in Peking, these results are thought to indicate that this louse may transmit the disease under certain circumstances. It is not known, however, whether *R. prowazeki* multiplies in it.

PANG (K. H.). **Studies on Typhus Fever Epidemic occurring in a Poor House. II. Etiological and epidemiological Studies.**—*Chin. med. J.* **62** no. 4 pp. 334–346, 23 refs. Washington, D.C. [1945.]

During studies of an epidemic of typhus that occurred in a poor house in western Peking in the spring and summer of 1940 with a recrudescence in the following spring, rickettsiae were isolated from the patients and from rats taken in the buildings, fleas (*Xenopsylla cheopis*, Roths.) and mites (*Liponyssus bacoti*, Hirst) from the rats, and lice [*Pediculus humanus humanus*, L.] from patients and apparently healthy persons. The methods used are described, the characteristics in laboratory animals of seven strains representative of all these sources are given in detail, and it is concluded that all were of the murine type [cf. *R.A.E.*, B **30** 191, etc.]. At the beginning of the epidemic in 1940, the inmates of the institution were heavily infested with body lice and during the summer, some, including all those who developed typhus, still carried lice. The 30 rats trapped in the buildings were all *Mus (Rattus) norvegicus*, and ten were infected. Fleas were the most common ectoparasites on them. *X. cheopis* was the only species found during the greater part of the year, but *Ceratophyllus anisus*, Roths., was more common in spring, though

the total number of fleas was much less and the number of *X. cheopis* very low. *Liponyssus bacoti* was found on only six rats and in small numbers, and though it is known to attack man and so might be able to transmit typhus from rat to man, there was no evidence that it played any significant part.

Differences in the seasonal prevalence of the epizootic and epidemic and in their distribution within the poor house suggest that they may have been progressing concurrently but independently of each other and the occurrence of inapparent infections in children and of infected lice on apparently healthy persons also indicated that man may be an important factor in maintaining typhus infection.

**Moose Sickness in Nova Scotia.**—*Rep. Dep. Lds For. N.S. 1947* pp. 100–103. Halifax, N.S., 1948.

It is reported that high mortality of moose from an unknown cause has occurred in Nova Scotia in spring and summer during the past 20 years and is believed to be associated with heavy infestation by *Dermacentor albipictus*, Pack. [cf. *R.A.E.*, B 20 225 ; 32 85]. This is a one-host tick, and infests the animals only in winter [but cf. 31 137]; the engorged adults drop off the moose in the spring, and the females lay their eggs on the ground. The young hatch and remain clustered together until the onset of cold weather, when they climb on to the vegetation and are picked up by passing animals. The ticks remain on the host until spring, ingesting much blood, and this must seriously reduce the vitality of the host, particularly if it is already weakened by malnutrition. On 3rd August 1947, a yearling female moose was discovered in a sickly condition and brought in for observation. The main external symptoms were extreme emaciation, general weakness and partial blindness [cf. 20 225], but the animal fed well and its condition improved after a few days. On 12th and 13th August, however, paralysis developed in the hind legs, and progressively less food was consumed; there also appeared to be a stiffness in the neck region, but the animal did not seem to be in pain until shortly before death, which took place on 14th. Post-mortem examination of various organs indicated an acute encephalitis, probably caused by a virus; there was no evidence of parasitic infestation.

REITLER (R.) & MENZEL (R.). **Some Observations on *Salmonella* Strains in Dogs, Mice and Ticks.**—*Trans. R. Soc. trop. Med. Hyg.* 39 no. 6 pp. 523–527, 3 refs. London, 1946.

The following is largely taken from the authors' summary. *Salmonella* infections in dogs have been observed in Palestine, partly with *S. enteritidis* and partly with a new strain with the antigenic formula VI, XIV, XXIV-r-1, 7. This latter strain was also responsible for two epizootics in laboratory mice. It is very likely that ticks act occasionally as transmitters of salmonellas [cf. *R.A.E.*, B 32 84 ; 35 153], as *S. enteritidis* was found in a tick (*Rhipicephalus sanguineus*, Latr.) from a dog and *S. kirkee* (var. *immobilis*) in a tick from a hedgehog. Outbreaks in dogs occurred particularly where infestation with ticks was heavy.

BURTT (E.). **Observations on an Antbear (*Orycteropus afer*) in relation to Infection with *Trypanosoma rhodesiense*.**—*Trans. R. Soc. trop. Med. Hyg.* 39 no. 6 pp. 529–532, 1 ref. London, 1946.

Vanderplank suggested that the lower the normal temperature of a mammalian host of *Trypanosoma rhodesiense* before infection, the higher was the subsequent transmissibility of the trypanosome in *Glossina* and the shorter

the length of life of rats bitten by the infected tsetse-flies. However, the low transmissibility in *Glossina morsitans*, Westw., that he obtained with a strain passed through an antbear (*Orycteropus afer*) that had a temperature of 97°F. before infection [R.A.E., B 29 185] did not conform with the first part of the suggestion.

In the present paper, an account is given of experiments in which 1.5 per cent. of *G. morsitans* feeding on an infected antbear that had had a normal temperature before infection of 95°F. developed infection of the salivary glands and rats bitten by the infected tsetse-flies lived on an average for 40.5 days. These results thus agree with those of Vanderplank in the low rate of infection found in the flies, but do not support his suggestion that the transmissibility and virulence of a strain of *T. rhodesiense* may be enhanced by passing through animals with a low mean body temperature.

DE MEILLON (B.) & DAVIS (D. H. S.). *Pulex irritans*.—*Trans. R. Soc. trop. Med. Hyg.* 39 no. 6 p. 544. London, 1946.

Attention has recently been drawn to the fact that *Pulex irritans*, L., which has been shown to be able to transmit plague, can adapt itself to a host other than man [R.A.E., B 36 178], and such adaptation would be particularly important as regards plague transmission if the host was a house rat. Records are given of the finding of this flea in the Union of South Africa 31 times on *Mus (Rattus) rattus*, 18 times on man and bedding, 7 times on a human case of plague or in a plague-infected house, once on a plague-infected mouse (*Mus musculus*) and three times on uninfected mice, six times on wild rodents, four times on dogs, once on a pig, once on a calf, and once on *Suricata suricatta*.

HOCKING (K. S.). The Use of "666" in the Control of *Ornithodoros moubata*, Murray.—*E. Afr. med. J.* 23 no. 2 pp. 50–55, 2 refs. Nairobi, 1946.

An account is given of experiments in which BHC (benzene hexachloride) was compared with DDT for the control of the tick, *Ornithodoros moubata*, Murr., which infests huts, rest houses and camps in East Africa [cf. R.A.E., B 36 190]. Preliminary tests had suggested that crude BHC (about 12 per cent.  $\gamma$  isomer) was far more effective than DDT, and laboratory experiments with it were accordingly carried out in which assorted stages of the tick were placed in trays and covered with two inches of dry earth, and a 5 per cent. solution in kerosene was atomised on the surface. The percentages of the ticks dead or moribund after six days were 98 and 100 (in two tests) when the rate of application was 25 cc. (1,250 mg. BHC) per sq. ft., 91 when it was 12.5 cc. and 33 when it was 5 cc., but when the ticks were retained below the soil by a layer of mosquito netting, an application of 25 cc. was ineffective. There was no mortality in trays sprayed with 25 cc. kerosene only or in untreated controls.

An experiment was then undertaken in four huts, approximately 18×60 ft. in area, with earth floors, grass roofs and low hessian walls, at Kampala Details Camp. The floors were sampled for ticks on 19th May 1945 and the samples indicated averages of 12.5, 8.5, 16.0 and 0.3 examples of *O. moubata* per sq. ft. The first and third huts were sprayed on 21st May with 4 per cent. solutions of DDT and BHC, respectively, applied with stirrup pumps at rates of about 625 mg. DDT and 1,250 mg. BHC per sq. ft., and the other two huts received no treatment. The tick populations in all four were sampled at intervals of about a week and averaged 2, 21, 1 and 8.5 per sq. ft., respectively, on 13th June. During the first week, ten dead ticks were found in 4 sq. ft. in the first hut and 18 in the third.

A further field experiment, involving the same four huts and three others also found to be infested by *O. moubata*, indicated that the tick could be

eradicated by repeated treatment with BHC. On 2nd July, the first and fourth huts were sprayed with 1,250 mg. DDT per sq. ft., and the remainder with the same amount of BHC, except for the fifth, which was left untreated as a control. All the huts were unoccupied during the experiment and counts were made weekly; the results are shown in a table. On 17th July, all huts except the first and third, which had already received two treatments, were given a further application of BHC. By 31st July, the huts that had received two treatments with BHC were free from ticks, but the other three, which had received two applications of DDT, one of BHC and one of each, respectively, still contained large populations, though the numbers had been much reduced. The failure to control the tick with a single application of BHC is attributed to its ineffectiveness against the eggs, and a second treatment after an interval of at least three weeks is therefore recommended. Even two treatments with DDT failed to effect eradication.

BRESCIA (F.), LAMER (V. K.), WILSON (I. B.), ROWELL (J. C.) & HODGES (K. C.). **Relative Toxicity of DDT Aerosols to Mosquitoes and *Musca domestica*. Insect Balance.**—*Ent. News* **57** no. 7 pp. 180–183, 5 refs. Philadelphia, Pa., 1946.

The authors refer to an experiment with DDT aerosols against salt-marsh mosquitos in the United States in which an aerosol emitted at the rate of 15 U.S. gals. emulsion (5 lb. actual DDT) per 1,000 ft. travelled by the generator was effective for a distance of 5,000 ft. down wind in open country [*R.A.E.*, B **36** 83]. They state that subsequent tests with various other insects of economic importance have shown that they would be little affected by an application of the aerosol at this rate, so that it would be unlikely to destroy beneficial insects or upset the balance of nature [*cf.* **34** 136], and give an account of tests of its effect on *Musca domestica*, L. The flies were confined in cages 100, 500 and 1,000 ft. down wind of the generator, and the velocity of the wind was 9 miles an hour. The generator was stationary, but its output was adjusted to be equivalent to applications of from 4.7 to 20 U.S. gals. along a line of 1,000 ft. The mortality figures are given in tables, and it is concluded from them that an output of 15 U.S. gals. per 1,000 ft. of front would be required to control the flies at a distance of 1,000 ft. down wind and that the flies are 4–6 times as resistant to the DDT aerosol as the mosquitos were.

#### PAPERS NOTICED BY TITLE ONLY.

GERBERICH (J. B.). **An annotated Bibliography of Papers relating to the Control of Mosquitoes by the Use of Fish** [298 papers published up to 1942 inclusive].—*Amer. Midl. Nat.* **36** no. 1 pp. 87–131. Notre Dame, Ind., 1946.

HILL (R. B.) & HILL (C. M.). **Catalogus insectorum jamaicensis. Supplement. A List of the Mosquitoes found in Jamaica.**—3 pp. Kingston, Dep. Agric. Jamaica, 1945. [*Cf.* *R.A.E.*, B **15** 14.]

MCNAMARA (B. P.) & KROP (S.). **Observations on the Pharmacology of the Isomers of Hexachlorocyclohexane** [benzene hexachloride in dogs and rabbits].—*J. Pharmacol.* **92** no. 2 pp. 140–146. 1948. **The Treatment of acute Poisoning produced by Gamma Hexachlorocyclohexane.**—*T.c.* pp. 147–152. (Abstr. in *Bull. Hyg.* **23** no. 7 p. 535. London, 1948.) [See *R.A.E.*, A **37** 15, 16.]

MALDONADO CAPRILES (J.). **The Fleas of Puerto Rico.**—*P. R. J. publ. Hlth* **21** no. 2 pp. 173–183, 8 figs., 11 refs. Brattleboro, Vt., 1945. (Also in Spanish pp. 184–192.)

The fleas that have been reported in Porto Rico are *Leptopsylla segnis*, Schönh., *Xenopsylla cheopis*, Roths., *Ctenocephalides canis*, Curt., *C. felis*, Bch., *Pulex irritans*, L., *Echidnophaga gallinacea*, Westw., and *Tunga penetrans*, L. A key is given to these seven and also *Nosopsyllus fasciatus*, Bosc, which, although not recorded there, is of world-wide distribution, together with diagnostic characters to assist their identification and notes on their hosts and general importance in the transmission of organisms pathogenic to man or animals. Outbreaks of plague occurred in Porto Rico in 1912 and 1921, following the finding of infected dead rats, and endemic typhus is present on the Island, especially in San Juan. The numbers of cases reported each year increased progressively from only two in 1940 to 157 in January–August 1944, but this may have been due to greater interest or improved methods of diagnosis. A rat-flea survey in San Juan in 1926–29 [cf. *R.A.E.*, B **18** 163, etc.] and an anti-rat campaign in 1943 showed that *Mus (Rattus) norvegicus* constituted about 70 per cent. of the rats present, followed by *M. (R.) rattus alexandrinus*, which had apparently increased somewhat in the interim, and *M. (R.) r. rattus*. Mice (*M. musculus*) were also taken in 1943. It is estimated that 8 per cent. of the rat population are carriers of endemic typhus. The survey showed that 57 per cent. of 1,005 rats bore fleas, of which 7,145 were taken; 98.5 per cent. of these were *X. cheopis*, giving a *cheopis* index of 7, as compared with a total flea index of 7.1.

PRINCE (F. M.) & McMAHON (M. C.). **Tularemia. Attempted Transmission by each of two Species of Fleas: *Xenopsylla cheopis* (Roths.) and *Diamanus montanus* (Baker).**—*Publ. Hlth Rep.* **61** no. 3 pp. 79–85, 6 refs. Washington, D.C., 1946.

To test the ability of fleas to transmit tularaemia, 304 individuals of *Xenopsylla cheopis*, Roths., in three lots and 201 of *Diamanus montanus*, Baker, in two lots, all bred in the laboratory, were given an opportunity to feed on infected white mice. From each of the five lots, 20 or more individuals were promptly triturated and the emulsion injected into mice; 68, 70 and 90 per cent. of *X. cheopis* and 80 and 95 per cent. of *D. montanus* were thus found to have become infected. Other fleas were killed immediately after the infective meal and stored dry or in saline for 3–13 days at room temperature (about 73°F.). They were then triturated, and injection of the emulsion often produced tularaemia in healthy mice when the storage period had not exceeded five days under dry conditions for both species and in saline for *X. cheopis* and seven days in saline for *D. montanus*. No tularaemia was produced in 46 white mice bitten 312 times by infected fleas (40 of *X. cheopis* and 19 of *D. montanus*) fed individually, or in guineapigs confined for 32 days with 25 fleas of each species that had previously been kept with infected mice. The disease was produced by the inoculation of infected fleas or of their faeces for varying periods after they had fed on an infected mouse. In the case of *X. cheopis*, the period was once 32 days, but this was exceptional.

It is concluded from these tests that *X. cheopis* and *D. montanus* do not play an important part in the transmission of tularaemia.

YAGER (R. H.) & GLEISER (C. A.). **Trichomonas and Hemoproteus Infections and the experimental Use of DDT in the Control of Ectoparasites in a Flock of Signal Corps Pigeons in the Territory of Hawaii.**—*J. Amer. vet. med. Ass.* **109** no. 834 pp. 204–207, 3 figs., 7 refs. Chicago, Ill., 1946.

When two sickly birds out of a flock of homing pigeons in Hawaii were killed for examination, they were found to be infested by tapeworms, lice, mites and

the pigeon fly (*Pseudolynchia canariensis*, Macq.) and to be infected by *Trichomonas gallinae* and *Haemoproteus columbae*, which is transmitted by *P. canariensis*. In view of the *Haemoproteus* infection, blood smears were taken from six other birds in the flock, and all proved to be lightly infected. The birds were found to be infested by the feather louse, *Columbicola columbae*, L., a feather mite, *Falculifer rostratus*, Buchholz, and *P. canariensis*.

An experiment on the control of these pests was carried out in two lofts, each containing 26 pigeons. Those from one of them were dusted with 10 per cent. DDT in talc applied at the rate of about 3 gm. per bird, and those from the other were dipped in 0.75 per cent. sodium fluoride, in which each bird was held for 30–45 seconds, the head being immersed for a moment. A third loft served as a control. All the birds were heavily infested with lice and mites and lightly with *Pseudolynchia*. DDT gave a complete kill of lice and flies within 24 hours and a marked reduction of mites after three days. The sodium fluoride dip was about as effective as DDT against the mites after five days and killed nearly all the lice in the same time. Infestation by the fly was too light for an estimation of control. The birds suffered no ill effects.

[PAVLOVSKIĬ (E. N.).] Павловский (Е. Н.). On the Theory of natural Foci of Diseases transmissible to Man. [In Russian.]—*J. gen. Biol.* 7 no. 1 pp. 3–33, 5 figs., 50 refs. Moscow, 1946. (With a Summary in English.)

The numerous investigations that have been carried out in the Soviet Union during the last 15 years on the epidemiology of Arthropod-borne diseases of man have shown that, like similar diseases in other countries, many of them are markedly local in occurrence and appear to be associated with definite centres or foci of infection. Foci that have arisen without human agency are termed natural, and they may exist in the complete absence of man and not reveal themselves until human contact with them is established, when they may disappear as a result of unfavourable conditions or become localised in human settlements. Natural foci are characterised by the presence of a disease organism, animal reservoirs in which it is maintained and Arthropod vectors by which it is transmitted, and all three of these elements form part of a natural association or biocoenosis adapted to a particular habitat. They may be limited in extent, for example to the burrows of wild animals, or be more diffused if the vectors are distributed over the ground or vegetation. When man appears in such zones, he may be infected by an Arthropod vector that has itself become infected from a wild animal, and this explains the primary incidence of infection in unpopulated regions. Human infection from a natural focus may result from the activity and mobility of the vector as in flying insects, from prolonged stay in the area, or from direct contact (as in skinning) with an infected animal reservoir.

The diseases for which the occurrence of natural foci have been proved in the Soviet Union are relapsing fever, transmitted by *Ornithodoros* spp., spring-summer encephalitis and spotted fever, both transmitted by Ixodid ticks, cutaneous leishmaniasis, transmitted by *Phlebotomus*, plague in wild rodents and their fleas, and tularaemia. Sandfly fever also occurs in foci [cf. *R.A.E.*, B 34 110], but has not been proved to have an animal reservoir.

In order to facilitate further studies, natural foci are classified into different types according to their individual characteristics, and it is pointed out that epidemics of Arthropod-borne diseases among troops or settlers in previously uninhabited areas can be avoided by preliminary investigations as to the existence of natural foci and appropriate preventive measures.

To illustrate the persistence of natural foci, the history of tick-borne relapsing fever transmitted by *O. tholozani*, Lab. & Mégn. (*papillipes*, Bir.) in the Republic of Kara-Kalpak in Central Asia, and also of sandfly fever transmitted

by *P. papatasi*, Scop., in the Crimea is discussed; both appear to date from early times.

[PETRISHCHEVA (P. A.).] Петрищева (П. А.). Sandflies (*Phlebotomus*) in various Landscape Zones of USSR. I. Sandflies in hot Deserts in Central Asia. [In Russian.]-*J. gen. Biol.* 7 no. 1 pp. 65-84, 4 figs., 15 refs. Moscow, 1946. (With a Summary in English.)

In view of the discovery by Latuishev [*R.A.E.*, B 32 172, 173; 34 77] that cutaneous leishmaniasis occurs in natural foci [*cf.* preceding abstract] and the probability that visceral leishmaniasis and sandfly fever also do so, the distribution of sandflies (*Phlebotomus*) in their natural habitats has become of epidemiological importance. Investigations were therefore made in the deserts in Turkmenistan, southern Tadzhikistan and Uzbekistan. Most of the work was done in sand desert, loess desert, which is covered with ephemeral vegetation, and stone desert, and little material was obtained from salt desert. The sandflies, which were collected chiefly on sheets of sticky paper, were very numerous and comprised practically all the species of *Phlebotomus* that occur in Central Asia, but each had its regions of prevalence. They were common in the burrows of gerbilles (*Rhombomys opimus*) and ground squirrels (*Spermophilopsis leptodactylus*) in the sand desert, the burrows of tortoises in the loess desert, and holes occupied by wolves, jackals and foxes in the stone desert. Details are given of their seasonal occurrence and abundance in or near these places, and the species associated with each are enumerated.

The conditions that render the burrows or holes of animals in the deserts suitable for the breeding of sandflies are discussed. The microclimate in them is characterised by a rather high humidity and moderate temperatures, and they afford shelter from the extremes of summer heat and winter cold and the strong drying winds that prevail outside. Moreover, they are frequently used as temporary shelters by various small mammals, reptiles or birds, on which the sandflies probably feed. Reptiles are abundant in the sand deserts, and notes are given on the species that occurred in the burrows of *Rhombomys* in association with *Phlebotomus* spp.

Sandflies were abundant in and near the burrows of *Rhombomys* and *Spermophilopsis* in the sand desert from the end of April till the middle of July and readily attacked man in the evening; their frequency varied with the size of the rodent colonies. They occurred at fairly great distances from the burrows during the evening and night, and it was often observed that they left them in numbers in the evening, and returned in the early morning hours. Tortoises were numerous in the loess desert and were active for about three months from March, when the vegetation appears, until May, when it dries up. They then remain dormant in their burrows for nine months, after having blocked the entrances with a thick layer of soil. Sandflies were common from mid-April until early May but none was observed after the end of May until the following spring. There was thus apparently only one generation a year, with a long developmental period in the burrows. In the stone deserts in the mountains, sandflies occurred from April to the end of November in holes occupied by wolves, and were most abundant for about two months in early summer. They were also numerous in the holes of jackals and foxes. They flew out during the evening and night and readily attacked man.

PRYOR (M. G. M.), RUSSELL (P. B.) & TODD (A. R.). Protocatechuic Acid, the Substance responsible for the Hardening of the Cockroach Ootheca.—*Biochem. J.* 40 no. 5-6 pp. 627-628, 5 refs. Cambridge, 1946.

From the similarity between the ootheca of *Blatta orientalis*, L., and the hard brown exocuticle of insects, it was inferred that the phenolic substance

responsible for the hardening of the former is also responsible for the hardening of the latter [cf. *R.A.E.*, B 35 99]. An account is given of experiments in which this substance was isolated from the ootheca of *B. orientalis* and identified as protocatechuic acid (3 : 4-dihydroxybenzoic acid) [cf. 35 100].

**E605—an interesting new Insecticide.**—*Agric. Gaz. N.S.W.* 59 pt. 10 pp. 537–538. Sydney, 1948.

Tests carried out overseas have shown that parathion (diethylparanitrophenyl thiophosphate), an insecticide also known as E605, Thiophos and 3422, is effective against a wide range of pests, but it is reported to be very toxic to man and warm-blooded animals. It is a heavy liquid, insoluble in water, and is compatible with a wide range of other insecticides and, according to some sources, stable in alkaline media. Some small-scale tests with it have been made in New South Wales [cf. also *R.A.E.*, A 37 42], including the two following by A. H. Friend. In one, against *Musca domestica*, L., a kitchen, 18×8×9 ft., was sprayed with  $\frac{1}{2}$  gal. of 0.7 per cent. parathion; no flies were seen immediately afterwards, although 10–20 active individuals had been seen each day for a week preceding the treatment. One fly was noticed a week after spraying, but soon disappeared, and freedom from flies was still maintained after three weeks.

The other test was against *Dermanyssus gallinae*, Deg., and lice on fowls; *Eomenacanthus stramineus*, Nitzsch, was the predominant louse, but *Goniocotes gigas*, Tasch., was also present. About 150 ft. of perches and nest railings of a poultry-house in which 25 fowls were kept was painted with  $\frac{1}{4}$  pint of 7.8 per cent. parathion, prepared by diluting a concentrate in water (1 : 10). Large numbers of living mites and a few dead lice were recovered on paper spread beneath the perches, and when the fowls were examined five days after treatment, a large reduction in the louse population was evident, although some birds were still moderately infested. The inner walls of the house, perches and nests were then sprayed with 2 gals. of 0.7 per cent. parathion, and one living engorged mite only was collected on the paper. When the fowls were examined again 15 days after the initial treatment, only two were found to be infested with lice. These were treated by rubbing 1 gm. of 2 per cent. parathion powder into the feathers of the underside, after which the lice immediately migrated from the treated area, and a few minutes later had either left the fowls or were dead or moribund among the feathers. The dusted fowls were cooped separately for a further week and remained free from lice. Eggs laid by these birds were cooked and sampled by various observers and found to have no taint.

**D'ABRERA (V. St. E.) & STORK (K. G.). Serological Reactions in "Tropical Eosinophilia".**—*Indian med. Gaz.* 81 no. 8 pp. 282–284, 12 refs. Calcutta, 1946.

The tests described were carried out in Ceylon on the sera of patients suffering from "tropical eosinophilia" and associated respiratory disorders and included agglutination tests with *Proteus* OX antigens, which were designed to determine whether the condition was due to a hitherto unknown rickettsia in the mites infesting the respiratory tract [cf. *R.A.E.*, B 36 200, etc.]. The blood sera of six patients were tested with type OX19 and OXK antigens, but all six were negative. The sputum of five of these contained mites; that of the sixth was not examined.

**CARTER (H. F.) & D'ABRERA (V. St. E.). Some Experiments on Toque Monkeys with Tyroglyphid Mites.**—*Indian med. Gaz.* 81 no. 8 pp. 284–287, 7 refs. Calcutta, 1946.

An account is given of three experiments carried out on two young adult males of *Macaca sinica sinica* with a species of *Tyrophagus* referred to as *T.*

*putrescentiae*, Schr., which appeared indistinguishable from one of the species commonly found in the sputum of persons suffering from respiratory disorders associated with high eosinophilia in Ceylon [cf. *R.A.E.*, B 33 11; 36 200]. The mites were bred in the laboratory from a pair collected from onions; the methods employed in rearing them are described. One test was made with their eggs and two with extracts prepared by grinding 1,000 mites in distilled water and adding more distilled water to bring the quantity up to 15 cc. The extracts were kept in cold storage for three months before use and were shown to be free from bacterial contamination.

On 16th February, 1944, about 200 mite eggs were introduced through the mouth into the trachea of an anaesthetised monkey of which the blood, immediately prior to this operation, gave a total leucocyte count of 10,000 per cu. mm. and an eosinophil count of 600 per cu. mm. To test the viability of the eggs, 20 from the same batch were kept in the laboratory; all hatched on 17th February, and the mites became adult on 29th and began to oviposit on 3rd March. Apart from a slight pyrexia and cough that began on 17th February, and soon disappeared, the monkey remained in good health until April, when an irregular and spasmodic cough developed and persisted for three months with paroxysms at intervals of a few days. The eosinophil count fluctuated at first but was considerably increased between May and August, ranging from 1,340 to 2,670 per cu. mm. and from 9 to 24 per cent. of the total leucocytes; the latter varied from 9,600 to 15,000 per cu. mm. From July onwards, the monkey seemed in good health and no cough was observed, but the eosinophilia remained high. No sputum was available for examination, but no mites were found in stomach washings.

The second monkey was given subcutaneous injections of 0.25, 0.5 and 1.25 cc. mite extract on 13th, 14th and 15th May, 1944. The injections were followed by a sharp transient rise in eosinophilia, but had no other apparent effect.

In the third experiment, which was begun in March of the following year, subcutaneous injections of mite extract, totalling 5 cc., were administered in four increasing doses over a period of five weeks to each of the monkeys used in the previous experiments. Both were in good health, but the increased eosinophilia in the first was still present. The injections had no apparent effect on the health of either monkey, or on the eosinophil count of the second, but that of the first dropped rapidly from over 2,000 per cu. mm. before treatment to 730 per cu. mm. three weeks after the first injection and was 200 per cu. mm. at the final examination eight weeks after the last injection. It is concluded that although no positive evidence of mite infestation of the respiratory system of this monkey had been obtained in the first test, the definite reduction in eosinophilia following the injections may indicate that a process of desensitisation had taken place.

SHORTT (H. E.). **Transmission of Kala-azar in India: the Case against the Sandfly—a Reply.**—*Indian med. Gaz.* 81 no. 8 pp. 310–315, 14 refs. Calcutta, 1946.

In this reply to a paper in which Malone & Brooks submitted evidence against the view that visceral leishmaniasis (kala-azar) in India is transmitted by *Phlebotomus argentipes*, Ann. & Brun. [*R.A.E.*, B 33 153], the author states that in some of the experiments from which they conclude that the life of *P. argentipes* in nature is very short, marked flies were recaptured for up to 15 days [24 306]; that the fact that the female sandfly possesses a spermatheca indicates that it normally oviposits more than once; and that, as regards the conditions under which the lives of the sandflies were prolonged in the laboratory, although the temperature was more stable than in the open it was not

necessarily more stable than in the crevices in buildings in which the flies customarily shelter. He considers that the feeding of the experimental stock on raisins is no more likely to invalidate the results obtained in the case of *Phlebotomus* than in that of mosquitoes, where it is the normal laboratory procedure; that there is no proof that sandflies do not feed on plant juices in nature; and that in any case such food is not at all necessary to produce the conditions known as "blocking", which he first described in sandflies that had not been so fed [14 143-144]. With regard to the view that kala-azar is a disease of the reticulo-endothelial system and of the skin, not of the blood stream, he points out that *Leishmania donovani* has been found in the blood of a high proportion of infected cases and furthermore, that its presence in the skin would facilitate insect transmission rather than otherwise [cf. 16 249]. Referring to the experimental transmission of the disease by ingestion [cf. 19 237], he states that he has also transmitted malaria to birds and monkeys by ingestion, and that this does not therefore invalidate the theory of insect transmission in nature. With regard to the relative distribution of *P. argentipes* and the disease, the fact that kala-azar is practically non-existent in some places where *P. argentipes* is present does not prove the latter to be incapable of acting as a vector if infected cases were imported; he believes that the presence of *P. argentipes* has been demonstrated in every area of India in which indigenous cases of kala-azar have occurred. As to the incidence of the disease in India in relation to age, sex and race, the evidence is judged to be too indefinite and contradictory for conclusions to be drawn. The failure of the disease to spread in schools and hospitals is considered to be unproven; in the case of hospitals the long incubation period might result in many of the patients having left before symptoms appeared.

BEQUAERT (J.). *Cuterebra* Larvae in a domestic Cat in Indiana (Diptera).—*Bull. Brooklyn ent. Soc.* 41 no. 5 p. 154. Lancaster, Pa., 1947.

Infestation of cats by larvae of *Cuterebra* in North America has occasionally been recorded [R.A.E., B 9 157; 13 101; 14 9; 32 126]. The author recently received three small larvae of this genus extracted from a subcutaneous abscess in a cat at Indianapolis, Indiana, in 1946. The larvae appeared to be in the second instar, but the species could not be determined. It appears that more precise comparative studies of the several larval instars of the species of *Cuterebra* must be made before the identity of the species infesting cats can be established.

BEQUAERT (J.). *Aedes aegypti* (Linnaeus), the Yellow Fever Mosquito, in Arizona (Diptera).—*Bull. Brooklyn ent. Soc.* 41 no. 5 p. 157. Lancaster, Pa., 1947.

In a recent monograph [R.A.E., B 35 120], *Aedes aegypti*, L., was not recorded from Colorado, Utah, Arizona or California. However, J. R. de la Torre-Bueno recently sent the author a male caught in his house at Tucson, Arizona, in October 1946, and stated that the species is well known in that locality, where it is fairly common in summer and often annoying indoors through its attacks on the ankles. It often bites during the day. If temperature conditions are favourable, breeding continues during the winter.

[Mosquito Control Work in 1944 & 1945].—*Proc. N.J. Mosq. Ext. Ass.* 32 261 pp., text ill., refs. New Brunswick, N.J., 1945. *Op. cit.* 33 185 pp., text ill., refs. 1946.

These two reports, for 1944 and 1945, respectively, are similar in arrangement to previous ones [R.A.E., B 34 22, etc.] and, in addition to accounts of mosquito

situations and control work in various parts of the United States, which are primarily of local interest or have particular reference to the army and conditions brought about by war or contain information that has been noticed from other sources, both contain reviews by F. C. Bishopp & H. H. Stage, entitled **A Review of Mosquito Work in a World at War in 1944** (pp. 13-35) and **A Review of Contributions to the Knowledge of Mosquitoes around the World during 1945** (pp. 123-147), respectively. **Mosquito Work in the other Americas** by C. H. Yeager (pp. 134-142, 3 figs., in the first report) and **Malaria Control in Central America** by R. R. Harris (pp. 154-158 of the second) both deal with the work done under the auspices of the Inter-American Co-operative Health Services in Latin-American countries. The first of these papers includes brief accounts of a typical preliminary malaria survey and of the functions of research laboratories, illustrated by work at Belem in Brazil, and a list of reported malaria vectors in areas investigated by the Service, with notes on the breeding places of the four principal ones. These are *Anopheles pseudopunctipennis*, Theo., which occurs in the west coast of South America from sea-level to 11,000 ft., in Bolivia, Chile, Colombia, Peru and Ecuador and also in Mexico and most of Central America; *A. darlingi*, Root, in Bolivia, Brazil, Colombia, Guatemala, Honduras, British Honduras, Mexico (along the Guatemalan boundary [cf. also 36 111]), eastern Peru and Venezuela; *A. albiparvus*, Lynch Arrib., in Brazil, Bolivia, Colombia, Trinidad, British Guiana, Venezuela and Paraguay; and *A. albimanus*, Wied., in Ecuador, Venezuela, Colombia, Panama, Costa Rica, Nicaragua, Salvador, Honduras, Guatemala, Mexico, Cuba, Haiti, and the Dominican Republic. Investigations by the Service were carried out in all these countries except Cuba and the British colonies. In the second paper, descriptions are given of permanent drainage projects carried out in Guatemala, Salvador, Honduras, Nicaragua and Costa Rica: temporary control measures include the use of Paris green, diesel oil and DDT as larvicides and of DDT as a spray to give a toxic deposit in houses. Other papers are noticed below, the first two being from the earlier report and the remainder from the later one.

In **Experiments using DDT for the Control of resting Adults of *Anopheles quadrimaculatus* Say** (pp. 57-61, 1 ref.), E. J. Hansens describes tests carried out in a summer camp in New Jersey, where adults of *A. quadrimaculatus*, Say, were found resting in numbers in 7×9 ft. wall tents and were continually emerging from a large breeding area in a neighbouring lake. Groups of tents were treated with 0.5, 1.0 or 3 per cent. DDT in kerosene; an emulsified solution of DDT in kerosene diluted to contain 0.4 or 0.2 per cent. DDT; a dust of 3 per cent. DDT in talc; the New Jersey pyrethrum larvicide [pyrethrum extract in oil emulsion (23 205)] diluted 1:5; or kerosene alone. A single thorough application was made, using a knapsack sprayer, small power sprayer or hand duster. Sprayed tents received  $\frac{1}{2}$ -1 U.S. pint of spray; it was applied both inside and out, but the inside received the greater portion. All the DDT sprays gave excellent protection against resting adults throughout observation, with little difference between them, but the dust was very inferior. The pyrethrum spray was effective for two days only, and kerosene, which apparently had some repellent effect, for about as long. Comparable results were obtained with similar treatments applied to the latrines, which were of painted wood.

In **A Technique for the Laboratory Rearing of *Anopheles quadrimaculatus* Say** (pp. 105-113, 1 fig., 1 ref.), R. E. Heal & M. M. Pergrin give a full account of a method based on that of Crowell [28 218], but incorporating modifications designed to overcome the tendency of the original method to produce stock that was not uniform in size or behaviour. The colony was maintained in an air-conditioned laboratory with a temperature of 74-76°F. and a relative humidity of 50-60 per cent. The features found of value in the production of uniform test insects were a known and constant population in the rearing pans, measured amounts of food for the larvae, the provision of brewer's yeast and

a bacteriological culture medium (Bacto brain heart infusion) as a supplement to dog food, and the use of covers on the rearing pans. In tests of the proportion of pupae produced in relation to density of population, it was seen that when larvae were hatched in distilled water, transferred to rearing pans within 12 hours, and fed twice daily with ground but unsieved dog food sprinkled from a salt shaker in amounts gauged by eye, the best results were obtained in pans containing 100 larvae. The pans held about three litres of distilled water and provided a water surface area of approximately 125 sq. ins. In pans with populations of 200-500 larvae, the percentages of larvae that pupated were lower and the pupae were small and irregular in size. Subsequent tests showed that 150 was the maximum number of larvae per pan that consistently gave a high yield of large and uniform pupae, and this maximum was not altered by modifications in the quantity or composition of the diet.

Since the amount of food administered from a salt shaker by different individuals was found to vary considerably, weighed feedings were tested and gave much more satisfactory results. To avoid the need for weighing each meal, small spoons were made to hold approximately 12, 50 and 100 mg., respectively, of dog food. Their accuracy was found to be within a range of  $\pm 15$  per cent. for the smallest and  $\pm 5$  per cent. for the largest. Dog food that had passed a 50-mesh screen was superior to material ground in the same way but from which the coarser particles had not been removed. The amounts of food provided per day for 150 larvae throughout the period of development are shown in a table; they increased from 12 mg. for each of the two daily feeds on the day of hatching to 300 mg. seven days later, and were then reduced as the larvae began to pupate.

When the diet consisted of dog food alone, difficulty was frequently experienced in rearing the larvae through the first instar, and this was not overcome until the diet was supplemented with a combination of brewer's yeast and the brain heart infusion that had proved successful in the rearing of *Aedes aegypti*, L. It was found that 100 mg. of each material added to the hatching pan just prior to hatching and 50 mg. of each added to each rearing pan at the time it was established gave the best response, the average time required to reach pupation being shortened by about three days and 95 per cent. of the larvae pupating. Provision of additional amounts of the supplements at the later stages of larval development appeared detrimental. The results obtained with either ingredient singly were only slightly inferior to those obtained with the two together [cf. 36 94, 193].

The use of plywood lids to keep the rearing pans covered, except at feeding times, prevented egg deposition by escaped adults of other species, permitted the stacking of the pans, retarded the evaporation of the water and so maintained its temperature, and also prevented contamination of the water surface by dust, a factor of particular importance for the well-being of first- and second-instar larvae.

**Field Experiments with DDT on Mosquitoes in 1945** (pp. 9-23, 4 refs.), by J. M. Ginsburg & E. J. Hansens, is an account of investigations on the duration of effect of DDT when applied to different kinds of mosquito breeding and resting areas in New Jersey. In catch basins, one application of mosquito oil (a mixture of fuel oils) containing 2.5 or 4 per cent. DDT usually prevented breeding for 6-8 weeks. Emulsified oil solutions containing 0.3 and 0.6 per cent. DDT did not remain effective any longer than oil alone. Xylene emulsions containing 2.5 per cent. DDT were effective for longer, but not for so long as oil with 2.5 per cent. DDT. In upland breeding areas, it appeared that single applications of mosquito oil containing 1 per cent. DDT made in July or August, at the rate of 32-50 U.S. gals. per acre, prevented mosquito breeding for about seven weeks. Similar applications of oil without DDT remained effective only for 8-12 days. In one instance, a heavy application of oil with

4 per cent. DDT remained effective for three months. A longer residual effect was obtained on clear than on heavily polluted water. In salt-marsh areas, in which the predominant mosquito was *Aedes cantator*, Coq., 1 per cent. DDT in oil, applied early in the season at the rate of 66 U.S. gals. per acre by means of a power sprayer developing about 450 lb. pressure, prevented breeding in stump holes for about three months. Attempts to exterminate fresh broods of adult mosquitos in marshes covered by tall, dense vegetation by applying DDT in oil from an aeroplane, a power sprayer and a Todd fog generator [cf. 35 128] proved unsuccessful.

The survival rates of caged mosquitos showed that none of the treatments was able to penetrate the vegetation sufficiently. Observations on the tents and latrines sprayed in July 1944 [37 23] indicated that treatment with 3 per cent. DDT in kerosene conferred protection against resting adults of *Anopheles quadrimaculatus*, Say, throughout 1945. The other DDT treatments were somewhat less effective.

**In Experiments with DDT for the Control of Mosquito Adults and Larvae in Fresh Water Areas in Morris County** (pp. 23-24), R. L. Vannote describes measures employed to curtail the annoyance caused by mosquitos in part of the Upper Passaic Valley in New Jersey as the result of a flood that occurred in the summer of 1945. In tests made over an area of meadow, open fields and woods, with some residential sections, 500 acres were sprayed with 3 per cent. DDT in an oil containing 0.1 per cent. pyrethrins and 300 acres with 1 per cent. DDT in fuel oil. Both were applied from an aeroplane at an average rate of 3 U.S. quarts per acre. Three hours after spraying, mosquito activity ceased. The sprays caused no damage and remained effective for about nine days, when mosquitos began to immigrate from untreated areas. Many were found to have survived in wooded areas where the sprays failed to penetrate. The 3 per cent. treatment was the more effective. Tests were also made in tall grass on the edge of the flooded area using the Todd fog applicator drawn on a trailer as adults of *Aedes vexans*, Mg., and *A. trivittatus*, Coq., were emerging. With 5 per cent. DDT in fuel oil, a complete kill was obtained at 100 ft. from the machine, and this area remained almost free from mosquitos for several days, but the fog lifted off the ground at about 125 ft. and the mortality at 150 ft. was only 50 per cent.

**Tests of a revolutionary Addition to Mosquito Control Procedures : Airplane Spraying for Control of adult Saltmarsh Mosquitoes** (pp. 25-29), by C. T. Williamson, R. D. Glasgow & D. L. Collins, is an account of experiments carried out during 1945 in Long Island, N.Y., on the effectiveness of spraying with DDT from an aeroplane against adults of *Aedes sollicitans*, Wlk. About 15,000 acres of salt-marsh area were sprayed with a 1 per cent. solution of DDT in fuel oil at the rate of 2 U.S. quarts per acre, 4-5 applications being made at intervals of about two weeks from early July onwards, according to the dates of emergence of the successive broods. From observations and counts, the control of adult mosquitos throughout the season was estimated at 90-100 per cent., and that of larvae after the first application at 70-80 per cent. Later, with the growth of the marsh vegetation, mortality of larvae decreased to 25-30 per cent. An analysis of records from five traps near the junction of salt- and fresh-water breeding areas in the years 1943-45 indicated that the ratio between fresh-water and salt-marsh mosquitos was 25 : 75 and 28 : 72 in the first two years, respectively, when both areas were treated alike, but 57 : 42 in 1945, presumably as a result of spraying. There was no indication of harm to wild life.

**In Treatment of Clothing for Protection against Mosquitoes** (pp. 65-69, 2 refs.), B. V. Travis & F. A. Morton describe tests in the laboratory against *Aedes aegypti*, L., and *Anopheles quadrimaculatus*, Say, and in the field against *Mansonia perturbans*, Wlk., and *Aedes taeniorhynchus*, Wied., made during

1942-43 in Florida [cf. **33** 107]. The following is taken from their summary. Mosquito bites through clothing can be prevented for periods ranging from several days to several weeks by a single treatment with dimethyl phthalate, Indalone (n-butyl mesityl oxide oxalate), Rutgers 612 (2-ethyl-1, 3-hexanediol), or a 6:2:2 mixture of these materials [cf. **34** 10], applied at the rate of 100-200 ml. per suit of shirt and trousers. The chemicals can be applied to clothing by hand, by means of sprayers, or by dipping the clothing in solutions in volatile solvents or in water emulsions. The duration of effectiveness is shortened when the clothing is saturated with sweat or water. Repellents are effective against mosquitos for several days when applied to lightweight fabrics and for at least one day on porous fabrics. This makes possible the use of large-mesh head nets and bed nets. Of the several untreated fabrics tested, Byrd cloth gave almost complete protection because of the nature of its weave. Khaki cotton twill was only moderately effective, and herringbone twill gave little or no protection.

In **The Use of the Blimp in Searching and Spraying** (p. 111), P. Huber suggests the use, on grounds of economy and efficiency, of small dirigible airships, such as those employed in air-sea rescue work, in surveys and spraying operations for the control of mosquitos. Their advantages over aeroplanes are that they are highly manoeuvrable, can fly very slowly or even hover over specific areas, can remain aloft for hours and can carry large quantities of spray materials.

KUMM (H. W.), OSORNO-MESA (E.) & BOSHELL-MANRIQUE (J.). **Studies on Mosquitoes of the Genus *Haemagogus* in Colombia (Diptera, Culicidae).**—*Amer. J. Hyg.* **43** no. 1 pp. 13-28, 6 pls. (1 col.), 1 map, 20 refs. Lancaster, Pa., 1946.

This study of the *Haemagogus* mosquitos of Colombia was undertaken as a result of the increasing recognition of the importance of members of this genus as vectors of endemic jungle yellow fever there [cf. *R.A.E.*, B **32** 184; **33** 112; **36** 113] and in Brazil [cf. **26** 65; **27** 121], and uncertainty as to the identity of the Colombian form variously referred to as *H. capricorni*, Lutz, and *H. janthinomys*, Dyar, which is the chief vector in Colombia. It is an arboreal mosquito [**32** 184], and no males have ever been taken in nature, though they have been reared from eggs laid by captured females. It is not yet possible to distinguish the females of some species with certainty, and the best morphological character distinguishing all the Colombian species of *Haemagogus* is the male terminalia.

The male terminalia of the mosquito in question differ from those described by Cerqueira & Lane for males of *H. capricorni* from the type locality in São Paulo, Brazil [**35** 121] and are morphologically much closer to those of *H. spegazzinii*, Brèthes, of which males reared from material obtained by Boshell in 1944 from Jujuy, Argentina, its type locality, and from the forest at Ribeirão da Fortuna, near Ilheus, Bahia, Brazil, agreed with those figured by Cerqueira from Bolivia [**35** 121]. *H. janthinomys* from the type locality in Trinidad proved identical with Boshell's material from the type area of *H. spegazzinii* in Argentina, so that the view that *H. janthinomys* is a synonym of *H. spegazzinii* is confirmed [**35** 121]. The Colombian form is therefore considered to be a subspecies of the latter, and is here described as *H. spegazzinii* subsp. *falco*, n.

Collections of adults and larvae from all over Colombia showed that it is the only form of *H. spegazzinii* present there, though larvae from Amazonas showed a slight variation in the lateral hairs of the anal segment. It is the commonest *Haemagogus* of Colombia, forming more than half of all the examples collected, and occurring in 37 of the 55 localities visited, and is particularly abundant

in the zone in which yellow fever is endemic. Its type locality is the forest known as Volcanes, in the valley of the Pitas river, Caparrapí, Department of Cundinamarca. In May and June 1943, yellow fever virus was isolated repeatedly and transmission was obtained by bite from females of subsp. *falco* caught there; the females collected also included *H. equinus*, Theo., and *H. lucifer*, H., D. & K., and because of the difficulty in distinguishing them at that time, it was not known whether all the virus came from subsp. *falco* or whether certain examples of *H. lucifer* were also infected. There was some seasonal variation in numbers, *H. equinus* becoming relatively more numerous, both males and females, towards the end of the season (October). No males of *H. spegazzinii* were taken there or by Boshell in Argentina or Bahia.

Females required for oviposition were successfully transported for long distances to the laboratory in shell vials with a supply of moisture and sugar-water for food. In preliminary tests of the viability of the eggs when kept dry, eggs from females caught in the Volcanes forest were kept for two weeks on damp paper towels and then completely dried. Over 50 per cent. of those submerged ten weeks later hatched, and many remained alive for at least six months, though more did so when the eggs were kept moist.

In addition to the three species already mentioned, five others were taken in Colombia. They were *H. anastasionis*, Dyar, *H. andinus*, Osorno-Mesa, the only highland species, *H. boshelli*, Osorno-Mesa, *H. chalcospilans*, Dyar, and *H. splendens*, Will., of which *H. celeste*, Dyar & N. Tov. [15 151] is a synonym, the males having proved identical with males of *H. splendens*, several examples of which were received by Komp in 1943 from the type locality in St. Vincent, but which were previously unknown. The relative frequency of all the eight is given in a table, their distribution is shown on a map and discussed, and characters differentiating the adults and larvae are given in tables and discussed. Keys to the male and female adults, the male terminalia and the larvae (except *H. chalcospilans*) are included.

[VINOGRADSKAYA (O. N.). Виноградская (O. H.). Functional Adaptations of the abdominal Spiracles in Mosquitos (Fam. Culicidae, Diptera). [In Russian.]—Dokl. Akad. Nauk SSSR (N.S.) 59 no. 6 pp. 1225-1227, 1 fig., 6 refs. Moscow, 1948.]

In further work on the spiracles of mosquitos [cf. R.A.E., B 31 188], the abdominal spiracles of ten species of *Anopheles* and two of *Aedes* were investigated, with special reference to the post-spiracular chamber. Their component parts are described, and figures for some of the species are given. Indices for all of them, obtained by expressing the diameter of the spiracle opening as a percentage of the maximum width of the distal portion of the post-spiracular chamber, are shown in a table. They ranged from 40 in *Anopheles superpictus*, Grassi, and 42 in *A. pulcherrimus*, Theo., which are resistant to dryness, to 80.5 in *A. plumbeus*, Steph., and 106.6 in *Aedes cinereus*, Mg., which are hygrophilous. The smallness of the spiracles in *Anopheles superpictus* and *A. pulcherrimus* is apparently an adaptation to life in a dry climate as it reduces the loss of water through the tracheal system [cf. 34 179].

BOHART (R. M.). A Key to the Chinese Culicine Mosquitoes.—Navmed no. 961, 23 pp., 19 refs., multigraph. Washington, D.C., Navy Dep., Bur. Med. Surg., 1946.

Keys are given to the adults and larvae where known of the mosquitos that occur in China, excluding Anophelines. Very brief notes are included on their

distribution within and outside China, together with indications of the species that are natural or experimental vectors of disease in China or elsewhere.

RAO (B. A.). **Malaria in the Irwin Canal Area, Mysore State. Part I.**—*J. Malar. Inst. India* 6 no. 2 pp. 101–108, 3 maps. Calcutta, 1945.

RAO (B. A.) & NASSIRUDDIN (M.). **Malaria in the Irwin Canal Area, Mysore State. Part II.**—*T. c.* pp. 109–128, 3 charts, 3 refs.

The first of these papers consists of a description of the area under consideration and the effect of irrigation from the Irwin Canal, which began in 1932. The epidemiology and control of malaria there is discussed in the second. Following the beginning of irrigation in January 1932, an increase in the incidence of the disease was reported in April, and a widespread epidemic was in progress before the end of the year. In many villages, spleen rates increased from 0–12 per cent. to more than 50 and sometimes as much as 90 per cent. The number of cases of malaria indicated the existence of a season of high incidence from March to June and another less marked from October to December.

Reference is made to a paper in which were recorded the results of examination for malaria parasites of Anophelines from several parts of Mysore in 1932–33 [*R.A.E.*, B 23 17]. *Anopheles culicifacies*, Giles, was the only species found infected in the Mandya (epidemic) area (part of that under consideration), but both it and *A. fluviatilis*, James, were infected in the Nagenhalli area some 20 miles away, where it bred in irrigation channels, swamps, pools, borrowpits and freshly transplanted and fallow rice-fields, but its breeding in the rice-fields was practically confined to six weeks when no females were found naturally infected. It would not be practicable to treat extensive areas under rice, but dusting of the other breeding places in this area with Paris green resulted in a marked reduction in spleen and parasite rates, most noticeable about 18 months after the measures were begun [22 69].

In view of this, experimental control was tried in a group of ten villages near Mandya. A detailed survey of Anopheline breeding places within a quarter of a mile of each village was made, and adults were collected weekly. The adult catches comprised 14 species, including *A. culicifacies*, which was common, and *A. fluviatilis*, which became abundant after 1933, when the last dissections were made [23 17], and is considered a potential vector on the basis of its infection at Nagenhalli. The irrigation channels and reservoirs, valleys, ponds and fields of rice and sugar-cane were the chief Anopheline breeding places. *A. culicifacies* occurred in them all, and *A. fluviatilis* in nearly all. From early in 1935, all irrigation channels, seepages, reservoir edges, etc., favoured by *A. culicifacies* were dusted weekly with 1 per cent. Paris green. Records of adult catches indicated a general fall in the average numbers of *A. culicifacies* and *A. fluviatilis* per catching station between 1935 and 1939, whilst the average for other species was rarely affected. Until April 1939, spleen and parasite rates showed a general downward trend both in the treated villages and in four untreated control ones, but the fall in the former was more pronounced. The spleen rates in treated and control villages showed highly significant differences between April 1936 and April 1939, and differences in parasite rates indicated a marked effect from April 1935 to October 1938. About July 1939, the effects of treatment were seriously influenced by increases in the area under wet cultivation within the treated zone, and a sudden rise in spleen and parasite rates occurred in all the groups of villages.

It is concluded that, as the system of crop rotation practised in the area (unlike that in Nagenhalli) made it possible for freshly transplanted rice to be present all the year round, control of *A. culicifacies* over an area extending a quarter of a mile from the villages, in breeding places other than rice-fields, was ineffective in preventing the transmission of malaria.

SENIOR WHITE (R.), GHOSH (A. R.) & VENKAT RAO (V.). **On the Adult Bionomics of some Indian Anophelines : with special Reference to Malaria Control by Pyrethrum-spraying.**—*J. Malar. Inst. India* **6** no. 2 pp. 129–215, 3 graphs, 47 refs. Calcutta, 1945.

The literature on the control of malaria in India by the use of pyrethrum sprays against Anophelines in huts and other buildings is reviewed at some length, and details are given of extensive investigations on this subject and on relevant aspects of the bionomics of species that transmit malaria made by the authors mainly at Chatikona Summit in the Jeypore Hills. A preliminary note on the practical applications of the work has already been noticed [*R.A.E.*, **B** **33** 135]. The tests were made in brick and tile railway quarters and village huts of various types. It was found that digestion of the blood-meal in females taken in collections begun three hours after daybreak was already fairly well advanced, so that an error is introduced if there are not enough collectors to search all stations simultaneously. However, by rotating the starting place, this error is evenly distributed over the data.

The results are given of laboratory studies on the duration of the gonotrophic cycle at different seasons in six species of *Anopheles* and the relation of ovarian development to digestion. Infectivity and ovarian development are difficult to assess and cannot be adopted as routine indications of the effectiveness of spraying in preventing mosquitos from surviving long enough to become infective, but it was hoped that correlation between ovarian development and digestion, might permit the use of the latter, which is easy to record. However, though very high correlations were found at certain stages, none was observed that was of any practical value. From March 1942, to February 1943, 1,832 fed females of the six species of *Anopheles* previously shown to become infected in the Chatikona area [*cf.* **25** 192 ; **36** 36] were collected in houses, cattle sheds and empty shelters, and the blood in them was identified as human, bovine or both by precipitin tests. *A. culicifacies*, Giles, showed an anthropophilic index [**33** 135] of 27.2 per cent., which is much higher than appears usual in India, yet it has never been found with sporozoites in the locality, it had the lowest oöcyt rate (0.2) of the six species and is considered unimportant as a vector. In Pattukkottai, it maintains endemic malaria though its anthropophilic index is only 2.5, its sporozoite rate is low, and the proportion of females that survive for ten days, and can alone be responsible for transmission, is small [**31** 169]. The authors presume that in the Chatikona area, an even smaller percentage survives so long, or perhaps none. The anthropophilic indices of *A. fluviatilis*, James, *A. varuna*, Iyen., and *A. minimus*, Theo., were 84.2, 79 and 92.4 per cent., respectively.

Experiments on the recapture of marked mosquitos in which mosquitos marked with dusts are liberated in buildings were shown to be invalid, as in the authors' tests much of the dust was rubbed off on to cobwebs and picked up by fresh individuals. Observations in which mosquitos were marked with 1 per cent. water solutions of eosin and methylene blue indicated a high rate of survival for over 12 days in cold weather in the three species tested (*A. fluviatilis*, *A. minimus* and *A. jeyporiensis*, James). The numbers of adults of eight species found in buildings of various types of construction with and without human or bovine bait and the percentages in the various wing stages and stages of blood digestion are given in a table and discussed. They show that *A. culicifacies* remains in dwellings (though not in cowsheds) until digestion is nearly complete [but *cf.* next abstract] and so is susceptible to spaced spraying, but that the vectors of the *fluviatilis* group (*A. fluviatilis*, *A. varuna* and *A. minimus*) leave the feeding place when the cycle is only half completed and thus are exposed to spray-killing for only one daylight period of each cycle [*cf.* **33** 135 ; **34** 194–195]. The validity of deductions as to age, drawn from wing

state, is shown to be very doubtful. Such deductions did not support the theory that the local failure of *A. culicifacies* to transmit malaria is due to short life. The remaining species studied (*A. subpictus*, Grassi, *A. vagus*, Dön., *A. aconitus*, Dön., and *A. jeyporiensis*) were predominantly animal feeders.

The proportion of the total catch of each species for the year taken in each month from March 1942 to February 1943 and the percentage in wing stage I are shown in a table, together with meteorological data, and are discussed, the same data for males are given in another table, and the fluctuations in population are compared with those observed by Ribbands in African Anophelines [33 34].

Data are given on night catches of *A. fluviatilis* made in 1944 in sprayed rooms at two stations and unsprayed rooms at a third and highly malarious place. The observations showed that the mosquitos entered chiefly between midnight and 5 a.m. [but cf. 34 195] and strongly suggested that spraying with pyrethrum and kerosene repels them from entering rooms at night, probably mainly through the action of the kerosene. An account is given of experiments with a mosquito trap, which confirm that the repellent effect of pyrethrum spraying prevents the females from entering and not merely from remaining after they have fed. It was more marked in rooms with mud walls than those with brick walls.

The effect of different spray-spacings against five species thought from the results of dissections or from prevalence to be of actual or potential importance locally (*A. culicifacies*, the three members of the *fluviatilis* group and *A. jeyporiensis*) are tabulated and discussed. However, the work of Hadow [30 183] and of Eddey [33 201], published after the authors had begun their experiments, is accepted as vitiating the latter's results from individual rooms in a single locality. Two large-scale experiments of spraying at various intervals were accordingly made in the Singhbhum Hills, involving 17 species among which members of the *fluviatilis* group were the only vectors [26 233]. The results obtained showed that pyrethrum is effective to different degrees in reducing the numbers of various species, the *funestus*-series (*A. fluviatilis*, *A. varuna*, *A. minimus* and *A. aconitus*) being the most susceptible. Spraying six days a week was shown to be the most effective system against the *fluviatilis* group and is recommended when economically feasible. Because of an apparent tendency for some individuals of species belonging to this group to take longer than others to complete the gonotrophic cycle, the only spacing that had adequate effect against populations with a high infectivity rate was spraying on six consecutive days followed by three days without spraying. *A. fluviatilis* and *A. varuna* were found resting in shady positions on the banks of nullahs. Definite differences are shown to exist between house and outside populations of both species in respect of their infection rates and their anthropophilic indices. In the case of *A. varuna*, the differences are so extreme as to furnish evidence in support of the hypothesis that the name covers more than one species or biological race.

RAJINDAR PAL. On the Bionomics of *Anopheles culicifacies*, Giles. Part III. The Behaviour of Adults.—*J. Malar. Inst. India* 6 no. 2 pp. 217-238, 9 figs., 34 refs. Calcutta, 1945. Part IV. Hypothesis of the Races of *A. culicifacies*.—*T. c.* pp. 239-241, 1 fig., 6 refs.

The first part [R.A.E., B 32 150] of this series on the bionomics of *Anopheles culicifacies*, Giles, was concerned with the length of life of females under controlled conditions, and the second [36 33] with oviposition and the immature stages. In the third, the author discusses the behaviour of adults in nature, largely from observations made in and around Delhi between 1939 and 1943. The seasonal prevalence of the species varies markedly in different parts of India [29 4]; it was prevalent throughout the year in Delhi and its vicinity,

though its density was highest during the spring and the hot humid months of July, August and September, particularly the last, when both adults and larvae were more plentiful than at any other time owing to the monsoons and the flooding of the Jumna River. There were great differences in abundance from year to year. It was evident that temperature and relative humidity played an important part in determining population, but that erratic rainfall and riverain flooding also had a great influence by forming abundant breeding places.

The number of *A. culicifacies* taken per man-hour in buildings housing man, animals or both never averaged more than 3·4 during normal years, but it reached 25 during a regional malaria epidemic in September 1943. A density of about 5·4 per man-hour appeared to be the limit below which this species does not transmit malaria [cf. 31 170].

The most favoured daytime resting places are the interiors of dark houses and cowsheds and often crevices and holes inside such buildings. The temperature and humidity conditions inside the usual resting places are compared with those recorded in a Stevenson's screen and shown to be considerably more favourable. Temperature has a much smaller range and relative humidity is very much higher. *A. culicifacies* feeds on either man or cattle, according to a number of factors. Results of precipitin tests on this species carried out by different workers in India are given in an appendix. The percentage of positives that reacted to human blood in the author's tests during the Delhi epidemic of 1942 was 10·7 [cf. 32 151–152]. The maxillary index was about the same (13) as that recorded for the same species in a non-epidemic period by Senior White in a paper already noticed [26 35]. The sporozoite rate among 665 females dissected for gland infection was 1·5 per cent. [cf. 32 151–152]. A large number of laboratory and field experiments showed that the biting activity of *A. culicifacies* gradually decreased after midnight. One female out of several hundred marked was observed to return after oviposition for a further blood-meal on the same night. There was shown to be a complete turnover of the population in houses each night. Indirect evidence supported the opinion that *A. culicifacies* does not ordinarily fly more than half a mile from its breeding place [cf. 23 18; 29 4], but indicated that it may travel longer distances, especially when not impeded by such obstacles as high buildings or trees.

The fourth part consists of a summary of intensive morphological studies of the eggs, larvae and adults of *A. culicifacies* from parts of India where it is a vector of malaria and others where it is not, undertaken in view of Senior White's suggestion that it might be a composite species [29 72]. No differences indicative of the existence of separate races were found.

VISWANATHAN (D. K.), RAMACHANDRA RAO (T.) & RAMA RAO (T. S.). **The Behaviour of *Anopheles fluviatilis*. Part IV. Experiments on the Behaviour of gravid Females.**—*J. Malar. Inst. India* 6 no. 2 pp. 243–245, 3 refs. Calcutta, 1945.

In this fourth paper of a series on the behaviour of *Anopheles fluviatilis*, James, in North Kanara District, Bombay Presidency [cf. *R.A.E.*, B 36 35, etc.], details are given of four experiments made between December 1944 and April 1945 in which fully gravid (Class E) females [cf. 34 194] were marked with gold or silver dust and released in a tent or in a specially constructed thatched mud hut with a floor space of  $15\frac{1}{2} \times 11\frac{1}{2}$  ft. and wall and gable heights of 5 and  $8\frac{1}{2}$  ft., respectively. Out of 100 females released in the tent at 4 p.m. on 3rd December, two were recaptured in it with empty abdomens (Class A) within one hour after dusk and six were taken in a neighbouring house, two with empty abdomens before midnight, three containing freshly ingested blood (Class B) the following morning, and one when it had half digested blood and half developed eggs (Class C) at 9 p.m. on the following night. Thus, all the

eight recaptured females had oviposited and returned to a place of feeding and were ready to feed or had fed on the night of release. Out of 89 females released in the tent at 10 p.m. on 21st December, 86 left it within an hour, and one was recaptured in Class A in the tent one hour after release and one in Class B in the house at 7 a.m. on 23rd December. In the third experiment, 42 marked females were released in the hut at 6 p.m. on 6th February, and none remained at 8 p.m. One in Class A was recovered in the neighbouring house at 11 p.m. and one containing very fresh blood on the following night at midnight. In this experiment, 18 females in Class C were also released; all had left at 8 p.m., none was recovered the same night, but two, both in Class A, were recovered in the hut at 9 and 10 p.m. on 7th February. This confirmed that members of Class C rest out of doors [34 195]. In the last experiment, 54 females in Class E were released in the hut at 6 p.m. on 7th April, and none remained in it at 9 p.m. Three in Class A were recaptured in it at 11 p.m., midnight and 3 a.m., respectively, and two in Class C at 9 p.m. on 8th April. Thus, of the 285 females released in Class E in the four experiments, 15 were recaptured in conditions indicating that they either had had or were ready to take a blood-meal on the night of release and two others fed on the subsequent night. The finding that all members of a batch of fully gravid females do not complete their blood-meals on the same night has a practical bearing on malaria control by a programme of spraying against the adults based on rational spacing of spraying days [33 135-136; 34 195], and this is discussed. Spraying for two consecutive days with one and two free days intervening alternately is recommended if it is not possible to combine measures against the larvae with those against the adults.

NAGENDRA (S.). **Dry Leaf Packing for the Control of Mosquito Breeding (Abstract).**—*J. Malar. Inst. India* 6 no. 2 p. 251. Calcutta, 1945.

Larvae of Anophelines and other mosquitos were present from March to May 1944 in a canalised perennial stream running in the bed of a nullah in a forest region near Pachmarhi, Central Provinces, but none could be found during the same period in 1945 after the stream had been packed with a thick covering of dry leaves to form a mechanical barrier against oviposition. There were also no larvae in two other streams treated in the same way, but some were found in similar streams nearby, which had been canalised and oiled. Packing is simple and cheap, where a plentiful supply of dry leaves is available, but would be useless in the monsoon season, when the heavy rains would wash away the cover.

MUSPRATT (J.). **Observation on the Larvae of Tree-hole breeding Culicini (Diptera: Culicidae) and two of their Parasites.**—*J. ent. Soc. sthn Afr.* 8 pp. 13-20 5 figs., 15 refs. Pretoria, 1945.

A list is given of the mosquito larvae, comprising 12 species of *Aedes* and two of *Culex*, taken by the author in tree-holes in the neighbourhood of Livingstone, Northern Rhodesia. Four species of *Aedes*, including *A. aegypti*, L., and one of *Culex* were abundant. The tree in which most of the suitable rot-holes were found was *Ricinodendron rautanenii*. Two kinds of parasite were observed infesting the haemocoel of many of the larvae: a nematode probably of the genus *Mermis* and a ciliate [cf. *R.A.E.*, B 9 190; 10 85] of which there were two types (A and B). The nematode and the ciliates of type A, which multiplied very rapidly, filling the haemocoel with a mass of protozoa within 3-4 days of entering, usually destroyed the host. Both occurred in all the abundant species. The other ciliate reproduced very slowly and may be only a

form of type A. Larvae of *Aedes aegypti* bred in the laboratory were infected with the ciliate of type A and with the nematode from water taken from infected tree-holes.

One or more nematode larvae might parasitise a single mosquito larva. They usually attained lengths of 25–33 mm. by the time they left the host, which was after at least 12–14 days. Similar nematode parasites have been found by the author in larvae of Anophelines (including *Anopheles gambiae*, Giles) and of other mosquitos from swamp pools and stream-bed pools at Livingstone and at Barberton in eastern Transvaal, and by others in a larva of *A. rufipes*, Gough, at Odzi, Southern Rhodesia, in Anopheline larvae from the Ruanda Urundi district of the Belgian Congo and in mosquito larvae from South West Africa.

CRISTOL (S. J.), HALLER (H. L.) & LINDQUIST (A. W.). **Toxicity of DDT Isomers to some Insects affecting Man.**—*Science* **104** no. 2702 pp. 343–344, 4 refs. Lancaster, Pa., 1946.

An account is given of experiments in which the insecticidal activity of o,o'DDT, which has recently been isolated from technical DDT, was compared with that of p,p'DDT and of o,p'DDT, the major impurity in technical DDT [cf. *R.A.E.*, B **34** 191]. The melting points of the three isomers were 92–93°, 108.5–109° and 74–74.5°C., respectively. When tested as sprays against adults of *Musca domestica*, L., and *Anopheles quadrimaculatus*, Say, at identical concentrations and rates of application, o,o', o,p' and p,p'DDT gave 1, 0 and 50 per cent. mortality of the flies and 15, 20 and 89 per cent. mortality of the mosquitos. In tests against *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) by the beaker method [**34** 44], the first two gave no kill at 0.2 per cent., whereas the last gave complete mortality. The percentages of fourth-instar larvae of *A. quadrimaculatus* that died in 48 hours in acetone-water suspensions [cf. **36** 48] were 100 for p,p'DDT at 0.01 part per million, 16 and 85 for o,p'DDT at 0.01 and 0.03 p.p.m., and 17 and 100 for o,o'DDT at 5.0 and 7.5 p.p.m.

GUILHON (J.). **Propriétés insecticides des isomères de l'hexachlorocyclohexane.**—*C. R. Acad. Agric. Fr.* **32** no. 18 pp. 754–760. Paris, 1946.

The results are given of laboratory tests in France, some of which are noticed elsewhere [*R.A.E.*, A **37** 60], which show that while the  $\gamma$  isomer of BHC (benzene hexachloride) is the most toxic of the four known isomers to many insects [cf. B **33** 130], the other three also possess insecticidal properties.

When examples of *Trichodectes canis*, Deg., were left at a temperature of 30–35°C. [86–95°F.] in contact with the four isomers and with a sample of technical BHC that had shown superior toxicity, the mortality percentages after 8 hours were 54 for the  $\alpha$  isomer, 23.3 for the  $\beta$  isomer, 92.6 for the  $\gamma$  isomer and 75.4 for the  $\delta$  isomer, as compared with 100 for the technical BHC and 20 in the controls. Individuals that were exposed to the technical BHC appeared completely paralysed in one hour, whereas those in contact with the  $\gamma$  isomer were still active. In tests in which the insects were confined on paper on which a little of the  $\gamma$  isomer had been sprinkled until they were paralysed and were then removed, adults of *Musca domestica*, L., *Calliphora vomitoria*, L., and *Sarcophaga carnaria*, L., were all completely paralysed in 13–35 minutes; the time required for mortality was not observed for *Sarcophaga*, but was 75 minutes for *Calliphora* and ranged from 3½ to 16½ hours for different batches of *Musca*. Examples of *Culex pipiens*, L., and *Blattella* (*Phyllodromia*)

*germanica*, L., became paralysed in 30 and 60 minutes, respectively, but the time required for death of the cockroaches was four days. In a further test, in which a very small quantity of sugared water containing a minute particle of the  $\gamma$  isomer was placed on the lower surface of the end of the proboscis of an active and apparently healthy individual of *M. domestica*, total paralysis ensued in 13 minutes and death in 323 minutes.

To test the fumigant effect, adults of *M. domestica* were kept under glass jars in which an open tube containing one of the isomers had been placed. The average times in which complete paralysis ensued were 140, 108, 57 and 80 minutes for the  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$  isomers, respectively, whereas most of the controls were unaffected after 30 hours.

The superiority of technical BHC over the  $\gamma$  isomer in the earlier tests suggests that it may have contained either some unidentified isomers of still greater toxicity or one or more other toxic substances.

BRU (M.). **Nouveaux emplois insecticides de l'hexachlorocyclohexane.**—C. R. Acad. Agric. Fr. **32** no. 18 pp. 771–772. Paris, 1946.

Tests against various insects [cf. also *R.A.E.*, A **37** 60] were carried out with a sample of BHC (benzene hexachloride) in which the  $\gamma$  isomer predominated; it was obtained by partly dissolving crude BHC in methyl alcohol, removing the solid residue and evaporating the solvent. *Pediculus humanus humanus*, L., *Cimex lectularius*, L., and fleas were rapidly killed by spraying or atomising a solution of 0.2 gm. BHC in a mixture of 20 cc. trichlorethylene, 80 cc. carbon tetrachloride and 0.5 cc. terpeneol at 15 gm. per cu. m., and *Musca domestica*, L., and other insects [cf. *loc. cit.*] died within 12 hours after contact with walls that had been painted with 4 per cent. BHC by weight in linseed oil.

SMART (J.). **A Handbook for the Identification of Insects of Medical Importance.**—2nd edn.,  $10 \times 7\frac{1}{4}$  ins., xi+295 pp., 13 pls. (3 col.), 178 figs., refs. London, Brit. Mus. (Nat. Hist.), 1948. Price 20s.

In addition to corrections and revisions of detail, some extensive alterations have been made in this second edition of a work already noticed [*R.A.E.*, B **31** 247], largely to incorporate the findings of entomologists attached to the Allied fighting services, particularly in the Far and Near East. Adjustments and additions have been made to the keys and distribution tables in the chapter on mosquitos, and a table is given showing the distribution of species belonging to the group of *Aedes scutellaris*, Wlk. Additional information is included on the geographical distribution of species of *Glossina*.

The chapter on fleas by K. Jordan has been much extended by him and includes keys to the superfamilies of fleas, to the Old World families and subfamilies, and to the genera of families or subfamilies containing important species, together with notes on the important genera and species. Instead of the key to species of *Xenopsylla*, there is one to the groups of species, supplemented by notes on characters for the identification of species within the groups. The chapter on Arachnida by R. J. Whittick has been revised and slightly expanded by K. Mellanby.

**Memoranda on Medical Diseases in Tropical and Sub-tropical Areas.**—8th edn.,  $8\frac{3}{4} \times 5\frac{3}{4}$  ins., 396 pp., 113 figs. (1 fldg.). London, H.M. Stationery Office, 1946. Price 7s. 6d. net.

This handbook for medical officers, an earlier edition of which has already been noticed [*R.A.E.*, B **13** 68], consists of a series of memoranda, arranged

alphabetically, on the more important diseases and parasites of man in tropical and subtropical regions. It includes sections on dengue, filariasis, yellow fever, malaria, visceral and cutaneous leishmaniasis, sandfly fever, sleeping sickness, plague, relapsing fever and rickettsial infections, in all of which mention is made of the vector or vectors, and also one on myiasis; that on skin diseases contains an account of infestation by *Tunga penetrans*, L. There is also one on Arthropod pests in which brief notes are given on *Pediculus humanus humanus*, L. (*P.h. corporis*, Deg.), *P.h. capitis*, Deg., *Phthirus pubis*, L., bugs (*Cimex lectularius*, L., *C. hemipterus*, F., and Triatomines), fleas, *Sarcoptes scabiei*, Deg., ticks, ants, cockroaches, mosquitos, Simuliids, *Phlebotomus*, house-flies (*Musca domestica*, L., and *Fannia canicularis*, L.), *Stomoxys calcitrans*, L., blowflies, *Glossina* and *Auchmeromyia luteola*, F., including information on such points as appearance, habits, recognition and prevention of infestation, diseases transmitted if any, and control. The uses of DDT and zoological nomenclature are dealt with in appendices.

BRUES (C. T.). **Dragonflies as predatory Enemies of the Stable-fly** (*Stomoxys calcitrans*).—*Psyche* **53** no. 3–4 pp. 50–51, 2 refs. Cambridge, Mass. [1947.]

Accounts have recently been published of dragonflies commonly destroying *Stomoxys calcitrans*, L., on the Gulf coast of Florida [*R.A.E.*, B **31** 95; **34** 190; **35** 39]. The author here records that the fly was very numerous and troublesome at a camp on the shores of Cedar Lake in northern Manitoba in the evening of 5th July 1936 and was even more abundant early in the next evening, but disappeared in a few minutes following the appearance of great numbers of dragonflies during the long twilight. It did not reappear during the remaining weeks of the author's stay at the camp, but numerous dragonflies were seen feeding in the air overhead each evening.

HALL (D. G.). **The Blowflies of North America**.—*Thomas Say Foundn* **4**, 9¼ × 6¼ ins., [6+] 477 pp., 51 pls. (5 col.), 9 figs., 11½ pp. refs. Lafayette, Ind., Purdue Univ., 1948. Price \$6.50.

The introductory section (pp. 1–40) comprises brief reviews of the history of the taxonomic separation of Calliphorids from other families of Diptera, the importance of blowflies in transmitting human diseases or causing myiasis in man or domestic animals, and methods of control, together with notes on the collection and rearing of blowflies, the preservation of specimens, the preparation of genitalia for study, classification and terminology.

The remainder of the book consists mainly of descriptions of North-American Calliphorids (together with some Neotropical species), showing synonyms and including notes on distribution and generally on bionomics. The family, subfamilies and genera are also described, and keys are given to the adults of the major taxonomic units, genera and species and to the known larvae of the species of the subfamilies CHRYSOMYINAE and CALLIPHORINAE. Many new genera and species are described, and changes in nomenclature are made. The author shows that *Callitroga* is an earlier valid name for *Cochliomyia*. The species he recognises are *Callitroga minima*, Shann., which is Neotropical, and *C. macellaria*, F. (designated the type), *C. aldrichi*, Del Ponte [*cf. R.A.E.*, B **27** 2] and *C. americana*, Cush. & Patt., which are Nearctic and Neotropical. He adopts the name *C. americana* for the screwworm fly because, although he considers it a synonym of *C. (Somomyia) fulvobarbata*, Big. (1887), it may also prove to be synonymous with one or more of several earlier names, of which *C. hominivorax*, Coq. (1858), the one adopted by Aubertin & Buxton [**23** 11] and by Del Ponte [**27** 2], is not the earliest.

WILLIAMS (R. O.). **Veterinary and Animal Husbandry.**—*Rep. Dep. Agric. Zanzibar 1945* pp. 16–18. Zanzibar, 1946.

It is stated in the course of this report that during 1945 it was definitely established that *Glossina austeni*, Newst., is present and fairly widely distributed in Zanzibar. Trypanosomiasis of cattle also occurs there [cf. *R.A.E.*, B 11 189], but it appears almost certain that neither the fly nor the disease exists in Pemba.

VAN SOMEREN (E. C. C.). **Ethiopian Culicidae—the Description of a new *Eretmapodites* Theobald.**—*Proc. R. ent. Soc. Lond.* (B) 16 pt. 1–2 pp. 13–15, 1 fig., 3 refs. London, 1947.

*Eretmapodites hightoni*, sp. n., which was taken in a collection of mosquitos in the Kaimosi Forest, Kenya [*R.A.E.*, B 34 93], is described from the adults of both sexes. Sections of Haddow's keys to the known males and females of the genus [34 159] are amended to include the new species.

WOLFS (J.). **Sur les *Anopheles* de l'agglomération de Coquilhatville et sur leur rôle respectif dans la transmission du paludisme dans cette agglomération.**—*Ann. Soc. belge Méd. trop.* 25 no. 3–4 pp. 225–230, 2 refs. Brussels, 1945.

A list is given of nine species of *Anopheles* taken during 1944 in and about Coquilhatville, Belgian Congo, with notes on the distribution of adults and larvae of each. Coquilhatville is situated between the Congo and Ruki rivers and bordered by marshlands, and malaria endemicity there is low [*R.A.E.*, B 26 255–256]. The most abundant species in the adult collections were *Anopheles moucheti*, Evans, and *A. paludis*, Theo., of which about 8,000 and 7,000, respectively, were taken. They were found in both native and European quarters, the former in houses and the latter more often outside, on the verandahs. *A. gambiae*, Giles, was fifth in order of frequency, with 30 examples. The larvae of *A. paludis* were very common in a great variety of breeding places, but those of *A. moucheti* were found exclusively on islands in the Congo, among grasses flooded at high water. Larvae of *A. gambiae* were observed outside the town in ruts and drains. Their absence from the town is attributed to a stratum of limonite on the surface of the soil, which renders the water unsuitable for breeding. Outside the town, the layer runs deeper, but still appeared to affect the larvae enough to prevent most of them from completing their development.

Dissections of some 1,500 females of *A. moucheti*, the only known vector of malaria that was present in sufficient numbers, revealed a mean sporozoite index of 0.86 per cent. (the monthly index varying from 0 to 3 per cent.).

#### PAPERS NOTICED BY TITLE ONLY.

[SKVORTZOV (A. A.).] Скворцов (А. А.). **On the Permeability of Insect Integuments for Contact Insecticides.** [*In Russian.*]—*Advances mod. Biol.* 21 no. 2 pp. 249–256, 30 refs. Moscow, 1946. [See *R.A.E.*, A 37 43.]

NEAL (P. A.), SWEENEY (T. R.), SPICER (S. S.) & VON OETTINGEN (W. F.). **The Excretion of DDT (2,2-bis-(p-chlorophenyl)-1,1,1-trichloroethane) in Man, together with clinical Observations.**—*Publ. Hlth Rep.* 61 no. 12 pp. 403–409, 4 figs., 7 refs. Washington, D.C., 1946. [See *R.A.E.*, A 37 44.]

SMITH (C. N.), COLE (M. M.) & GOUCK (H. K.). **Biology and Control of the American Dog Tick.**—*Tech. Bull. U.S. Dep. Agric.* no. 905, 74 pp., 37 figs., 21 refs. Washington, D.C., 1946.

This detailed study of *Dermacentor variabilis*, Say, based on field observations and laboratory rearings carried out at Martha's Vineyard, Massachusetts, and on neighbouring islands, contains notes on its economic importance and distribution in the United States [cf. *R.A.E.*, B 26 249] and information, much of which has already been noticed, on its control by the destruction of meadow mice (*Microtus pennsylvanicus*) and the systematic treatment of dogs [31 229], which are dipped in a suspension of derris [26 251], or by spraying vegetation with DDT [35 25] or other materials [32 193]. Meadow mice (in the region studied) and dogs are the preferred hosts of the immature stages and adults, respectively, but the larvae and nymphs also engorge on other small mammals, particularly rodents, and the adults on various large mammals, including man [cf. 35 36].

In the laboratory rearings, caged small mammals, including meadow mice, rabbits, musk-rats (*Ondatra zibethica*), rats and squirrels, were used as experimental hosts, and the non-parasitic stages were maintained under conditions simulating those in nature. The resulting observations on the life cycle of the tick confirmed those already reported [26 250], although the actual duration of various periods differed to some extent. The normal incubation period out-of-doors was found to range from 36 to 57 days, and an unusually extended incubation period of 303 days produced larvae that survived for less than the usual time. An investigation of seasonal cycles showed that activity of larvae in the field began in March or April, reached a peak in March, April or May, declined as the season progressed but sometimes rose again to a peak in August or September, and ceased in September or October. Rearing records indicated that the individuals active before July had all hatched in the previous year, whereas those active later in the season had hatched in the same year. Activity of nymphs began in March or April, increased more or less steadily until July or August, and then declined until it ceased in September or October. Rearing records indicated that nymphs active before June had moulted in the previous year, whereas many of those active after June had moulted during the same season. Adult activity began in April, increased until June or July, and then decreased until it ceased in August or September. Rearing records indicated that most of the activity was by adults that had hibernated.

The course of an infestation started from four egg masses that were beginning to hatch on 29th July 1939 (representing individuals that would arise from females engorged early in the season) and two females that had completed engorgement on 19th July (late in the season) was studied through a complete generation in a simulated meadow, provided with a mouse run, on a greenhouse-type table in the laboratory yard. The combined sources produced an infestation of active larvae from 3rd August 1939 to 28th July 1940, of active nymphs from 25th August 1939 to 21st April 1941, and of active adults from 1st May 1940 to September 1941.

Marked ticks persisted in an area throughout the greater part of one season, but only 0.24–0.57 per cent. of those marked in one year reappeared in the next. Experiments with scented and warmed objects indicated that the tendency of the adult ticks to concentrate along the sides of roads or paths [29 137] was due to the scent of the host there and not to the warmth.

The time required for moulting by larvae and nymphs, the preoviposition period and the incubation period were shown to be closely correlated with temperature [26 250], and unfavourably low temperatures during these periods reduced the duration of survival of the ticks in the following stages. Unfed larvae and nymphs frequently survived a temperature of  $-4^{\circ}\text{F.}$ , and unfed

adults once survived this temperature and frequently survived 0°F. The activity of all stages ceased at a time of year when the temperature was still favourable for it, but was about to become unfavourable for engorged ticks. The part played by the photoperiod in this cessation of activity is discussed from the literature [cf. 30 68]. Moisture was found to be essential for the survival of all stages. All stages survived submergence for one day in fresh or sea water, adults for six and five days in fresh and sea water, respectively, and engorged larvae and nymphs for five days in fresh water. Neither relative humidity nor precipitation showed any correlation with activity or length of developmental periods.

An additional control measure that was tested consisted in burning the vegetation in April. This was followed by a reduction in the number of ticks; at the height of adult activity, the reduction was about 75 per cent.

*Ixodiphagus texanus*, How., an indigenous parasite of ticks in Massachusetts, seldom attacks *D. variabilis* there. Attempts to establish *Hunterellus hookeri*, How., have proved unsuccessful [32 76].

KING (W. V.) & HOOGSTRAAL (H.). **Species of *Aedes* (Finlaya) of the papuensis Group in the Australasian Region (Diptera, Culicidae).** *Proc. ent. Soc. Wash.* 48 no. 6 pp. 135-157, 5 figs. Washington, D. C., 1946.

The characters of the *papuensis* group of the subgenus *Finlaya* of *Aedes* are given, together with keys to the females of the 11 species and the 9 males and 7 larvae that are known. *A. subalbatarsis*, sp. n., is described from adults of both sexes and larvae from Netherlands New Guinea, and *A. novalbatarsis*, n. n., is proposed for *A. albatarsis*, Taylor [*R.A.E.*, B 33 134-135], as this name is preoccupied by *A. albatarsis*, Ludl., which is a synonym of *A. desmotes*, Giles. The larva of *A. novalbatarsis* is described, and the morphology of the adult is discussed. *A. palmarum*, Edw., is considered distinct from it [cf. 33 135]. Descriptions are given of the adults of both sexes and larva of *A. dobodurus*, King & Hoogst., and *A. hollandius*, King & Hoogst., and the larva of *A. papuensis*, Taylor, and there are morphological notes on the previously undescribed male and larva of *A. argenteatarsis*, Brug. Brief notes are included on the breeding places of all the species discussed except *A. palmarum*.

ŌMORI (N.). **Observations on the nocturnal Activities of the Anopheline Mosquitoes in Taiwan. I. Preliminary Report.**—*Acta nippon. Med. trop.* 4 no. 1-2 pp. 59-67, 2 pls., 11 refs. Taihoku, 1942.

An account is given of studies carried out in 1939-40 on the nocturnal activities of Anopheline mosquitos in a village in Formosa situated at the foot of the mountains, 500 ft. above sea level. There were irrigated rice-fields and streams of running water in the neighbourhood, and the people kept cattle, pigs and poultry. A bait trap of mosquito nets, of the type described by Gater [*R.A.E.*, B 21 147], was used in the studies. A man occupied it from sunset onwards, and collections were made every hour or two hours by means of a chloroform tube and an electric hand lamp. The observations were made on nine occasions, covering every season except spring, the trap being indoors on rainy nights and outdoors in fine weather. The mosquitos were comparatively inactive when it was cold, rainy or cloudy. Results are shown in tables. Considerable numbers of mosquitos entered the trap throughout the night in July whereas their activity decreased considerably after midnight in October. This was probably on account of the higher temperature in July as well as an hour's difference in the time of sunset. The species could be roughly divided into three groups. The first, comprising *Anopheles maculatus*, Theo., *A. annularis*, Wulp, *A. hyrcanus* var. *sinensis*, Wied., and possibly *A. tessellatus*,

Theo., began to enter the trap just after sunset; their numbers reached a peak in 2-3 hours, diminishing gradually until midnight and very rapidly thereafter. The second, consisting of *A. minimus*, Theo., and possibly *A. splendidus*, Koidz., showed increased activity about midnight; and the third, comprising *A. jeyporiensis* var. *candidiensis*, Koidz., maintained sporadic activity through the night, showing no definite pattern. Two females of *A. ludlowi*, Theo., were also taken. *A. annularis* was by far the most abundant species, and *A. minimus* and *A. maculatus* were next in order of frequency, the total numbers taken being 2,151, 184 and 179, respectively. *A. minimus* has been considered the principal vector of malaria on the island, followed by *A. maculatus*, but in view of its numerical predominance, the author considers that *A. annularis* should be taken into account [cf. 21 158]. Notes are also given on the results of collections of larvae from streams and other water near the village. *A. annularis* and *A. maculatus* were most frequently taken, and larvae were also found of *A. ludlowi*, *A. aitheni* var. *bengalensis*, Puri, and *A. lindesayi*, Giles, species that were not attracted to man, and of *A. hyrcanus* var. *sinensis* and one each of *A. splendidus* and *A. minimus*.

HATCHETT (S. P.). **Chlorine as a possible Ovicide for *Aedes aegypti* Eggs.**—*Publ. Hlth Rep.* 61 no. 19 pp. 683-685, 1 ref. Washington, D.C., 1946.

In view of Roubaud's finding that a 1:1,000 solution of sodium hypochlorite induces the hatching and subsequent death of larvae of *Aedes aegypti*, L. [*R.A.E.*, B 15 161], experiments were made in Texas in 1945 with a commercial preparation of calcium hypochlorite that may be used in the chlorination of drinking water. Eggs, approximately two days old, laid by laboratory-reared females of *A. aegypti*, were used. Some were transferred directly to wide-mouthed jars containing 200 ml. water with enough of a freshly prepared stock solution of calcium hypochlorite to give 10-500 parts available chlorine per million, and were therefore continuously wet, while others were dried for 96 hours and then immersed in solutions containing 10-5,000 p.p.m. available chlorine. In the first group, eggs in solutions containing 500 p.p.m. free chlorine all died within 48 hours, while 50 and 100 p.p.m. induced many larvae to hatch but killed all of them. Eggs in the weakest solution hatched much more slowly, and over two-thirds of the larvae survived. In the second series, only solutions of 5,000 p.p.m. free chlorine destroyed all the eggs, but 74 of 99 larvae that hatched in solutions of as little as 10 p.p.m. died, indicating that drying made the eggs more resistant but the larvae more susceptible. It is concluded that solutions containing 0.007-0.014 per cent. calcium hypochlorite (50-100 p.p.m. free chlorine) would give effective mortality in either case. Although water so treated would be unsuitable for drinking, it could be stored for other purposes. The treatment could also be applied in barrels of drinking water in which mosquitos are breeding so as to cause eggs adhering to the sides of the barrel to hatch before it is emptied and refilled.

HORSFALL (W. R.). **Area Sampling of Populations of larval Mosquitoes in Rice Fields.**—*Ent. News* 57 no. 10 pp. 242-244, 4 refs. Lancaster, Pa. [1947.]

The following is substantially the author's summary. An area sampling device consisting of a cylindrical screen cage open at both ends and having a cross-section area of one square foot is an effective means of accurately comparing larval densities in a uniform habitat such as rice-fields. In plot and field tests in Arkansas, more accurate results were obtained with this device than with a dipper. In two plots where actual populations of larvae of *Psorophora confinnis*, Lynch Arrib., were as 1 to 4, the area sampler and a dipper showed ratios of 1:3.5 and 1:8.5, respectively. Under field conditions where a population of these larvae was low, 50 per cent. of the stations yielded larvae

with the area sampler, and only 27 per cent. showed larvae with the dipper. In an area where larvae were abundant, 95 per cent. of the stations showed larvae with the area sampler, and only 73 per cent. showed larvae by dipping.

HOVANITZ (W.). **Comparisons of mating Behavior, Growth Rate, and Factors influencing Egg-hatching in South American *Haemagogus* Mosquitoes.**—*Physiol. Zool.* **19** no. 1 pp. 35–53, 5 figs., 18 refs. Chicago, Ill., 1946.

The following is largely based on the author's summary. Laboratory observations on the mating behaviour of South American species of *Haemagogus* are described. It was found that these mosquitos differ with regard to the area or space needed for the mating dance, and the observed order (from small to large) of size requirement when *Aedes aegypti*, L., was also included for comparison was (1) *A. aegypti*, (2) *H. splendens*, Will., (3) *H. equinus*, Theo., (4) *H. lucifer*, H., D. & K., and *H. boshelli*, Osorno-Mesa, (5) *H. andinus*, Osorno-Mesa, (6) *H. spegazzinii*, Brèth., and (7) *H. spegazzinii falco*, Kumm, Osorno-Mesa & Bosh-Manr. The last three did not mate in captivity, and their relative positions were determined from activity only. The activity of *Haemagogus* spp. is at least partly correlated with mating, and the mating behaviour of the various species is compared with similar published data on *Anopheles* and *Culex*; in these genera, the nature of the behaviour suggests that it is determined by multiple-factor inheritance. The rates of development of *H. equinus*, *A. aegypti*, *H. splendens*, *H. spegazzinii falco* and *H. lucifer* were compared and the order of decreasing speed based on direct and indirect comparisons was found to be that given. The actual period required was variable, depending upon environmental conditions and inherent differences in each individual. *H. equinus* required a minimum of six days to reach the pupal and seven to reach the adult stage. The range of variation of a batch reared in the same pan at the same time approximated to the random variation expected round the mean of a normal curve.

The eggs of *Haemagogus* are deposited in damp places and the larvae develop in them but do not hatch until the eggs have been immersed in water. A comparison of data given by Buxton & Hopkins [*R.A.E.*, B **15** 197] for species of *Aedes* with the data for *Haemagogus* spp. showed that in both genera more eggs hatched during the day after immersion than on any subsequent day, but the percentage that hatched on any particular day and the total percentage hatch varied with individual females. The percentage hatch among eggs laid by females of *H. s. falco* collected at the same place but at different seasons differed more widely than that of eggs laid by females of *H. s. falco*, *H. equinus* and *H. lucifer* collected at the same place and at the same time, indicating seasonal and environmental influences, and some evidence was also obtained of the existence in *H. equinus* of genetic strains differing with regard to percentage of eggs that hatch. Different species of both *Aedes* and *Haemagogus* react differently with regard to the extent of hatching under similar stimuli. There seemed to be no correlation between the number of eggs laid by a female and percentage hatch. The factors influencing the capacity of eggs to hatch when subjected to a stimulus, which are distinct from the physiological mechanism that enables the eggs to remain quiescent, are discussed.

GIGLIOLI (G.). **Malaria, Filariasis and Yellow Fever in British Guiana. Control by residual D.D.T. Methods with special Reference to Progress made in eradicating *A. darlingi* and *Aedes aegypti* from the settled Coastlands.**— $10\frac{1}{2} \times 8\frac{1}{4}$  ins., x + 226 pp., 47 figs., 68 refs. [Georgetown] Mosq. Contr. Serv., Med. Dep. Brit. Guiana, 1948.

In this comprehensive report (the final report of the Malaria Research Service, which was amalgamated with the Yellow Fever Service under the title

"Mosquito Control Service" in January 1947), details are given of investigations on the spraying of houses with DDT for the control of disease-carrying mosquitos, made in British Guiana from February 1945 to June 1948 [cf. *R.A.E.*, B **35** 69]. Some of the general research undertaken in earlier years on the epidemiology and control of mosquito-borne disease is recapitulated [cf. **27** 229], in order to make clear the situation obtaining in the Colony as regards malaria, filariasis, caused by *Filaria (Wuchereria) bancrofti*, and yellow fever when the practical application of the method to control the mosquito vectors was instituted on an extensive scale in January 1947 and to facilitate evaluation of the results. Malaria is endemic or hyperendemic and particularly intense in the coastlands, which support 90 per cent. of the Colony's population. It is transmitted mainly by *Anopheles darlingi*, Root [**32** 17]. Urban yellow fever has not been recorded on the coast since 1909, but the jungle form exists over wide tracts of the interior, from which the settlements of the coastland heavily infested with *Aedes aegypti*, L., can be reached in an hour or two by aeroplane. Filariasis is very prevalent in the towns and larger villages; *F. bancrofti* is transmitted mainly by *Culex fatigans*, Wied., but *Anopheles darlingi* is also an efficient vector.

By April 1948, all the population of the coastlands and 78 per cent. of the total population of the Colony were being protected by DDT, and all the available evidence indicated that *A. darlingi* and *Aedes aegypti* had been eradicated from the areas treated (some 200 miles of coastland and estuary banks) and that *C. fatigans* had been controlled to a considerable degree in spite of very difficult hydrological conditions. Thomson's contention that DDT in kerosene irritates mosquitos, causing them to leave a house after feeding without acquiring a lethal dose [**36** 66], is refuted, and Thomson's poor results are attributed to the highly absorptive character of the surfaces he sprayed. The degree of malaria and filariasis control obtained cannot be assessed for some time as clinical evidence of both diseases persists long after transmission has ceased. It will not be possible to establish the part played in malaria transmission by *Anopheles aquasalis*, Curry, and *A. albitarsis*, Lynch Arrib., which bite man only accidentally, until *A. darlingi* has been eliminated, together with the reservoir of infection formerly maintained by it. It is pointed out that malaria control by DDT in a continental, water-logged, tropical country like British Guiana is a palliative measure, as the treated area is constantly open to reinfestation by the vector, and application of DDT must, therefore, be continued indefinitely to maintain permanent control. Malaria, reappearing after several years of remission, would be very serious in a population that had lost the tolerance that it now possesses.

The book is divided into seven parts. The first is introductory and includes data on geography, topography, geology, meteorology and population. The second is a discussion of the DDT preparations and spraying equipment used and the calculation of the dosage of insecticide, with brief notes on procedure. The third and longest section is concerned with the distribution and incidence of malaria in British Guiana and its effects, the distribution and breeding places of various Anophelines known to occur there, the habits of *A. darlingi*, and experiments on the application of sprays containing 5 per cent. DDT in solution in kerosene or in emulsion or 10 per cent. DDT in watery suspension, in houses to leave a toxic residue for Anopheline control, showing the different susceptibility of various species of mosquitos to control by this means, the intervals at which spraying should be repeated, and effectiveness (judged by mosquito populations and spleen, parasite and morbidity rates) under various conditions including an acute epidemic of malaria transmitted by *A. darlingi* in Indian villages in the highlands. In the fourth, the author discusses filariasis, with particular reference to a survey of infection on the coastlands in 1946-47 and to the effect of using DDT sprays in houses and also in pit latrines, the

most prolific source of *C. fatigans*. Part V is by P. F. de Caires and in it he deals with the control of yellow fever from July 1939 to 30th June 1947, discussing the inauguration of the Yellow Fever Service, the position at the outset, subsequent immunity surveys, international aspects of yellow fever control in British Guiana (the last place of call of aircraft and ships leaving the South American endemic area for the north) and the effectiveness against *Aedes aegypti* of the classical measures [cf. 28 18] and of supplementary spraying with DDT. The period between July 1947 and May 1948 is discussed by Giglioli in a brief addendum. The last two parts are concerned, respectively, with the effects of the DDT applications on house-frequenting Arthropods other than mosquitos and on small mammals and fowls, and with the organisation, progress and cost of the DDT campaign. Mosquito Control Regulations 1947, amended 1948, made under the Public Health Ordinance of British Guiana 1934, are quoted in an appendix.

Downs (W. G.) & Pittendrigh (C. S.). **Bromeliad Malaria in Trinidad, British West Indies.**—*Amer. J. trop. Med.* 26 no. 1 pp. 47-66, 7 figs., 19 refs. Baltimore, Md., 1946.

The authors discuss from the literature the investigations into the transmission of malaria by members of the subgenus *Kerteszia* of *Anopheles*, which occur in forests and breed in bromeliads, as a result of which it was found that *A. (K.) bellator*, D. & K., is an important vector in Trinidad, where the cacao plantations offer it particularly favourable conditions [cf. R.A.E., B 30 133; 32 211]. The day-time distribution of *A. bellator* in forests in Trinidad is compared with that of *A. (K.) homunculus*, Komp. The former is more abundant immediately below the canopy than on the ground, and is abundant at lower levels in clearings where conditions at ground level resemble those of the forest canopy, and on the outskirts of the forest, whereas the latter is most numerous at ground level in the forest, where conditions are highly humid and shaded, and since it seldom enters open vegetation it is probably only of minor importance as a vector [cf. 32 211]. In the cacao plantations, owing to the wide spacing of the interplanted immortal shade-trees (*Erythrina* spp.) and their deciduous habit in the dry season, there is more light and less humidity than in the natural forest, and *A. bellator* consequently occurs at lower levels, thus facilitating contact with people working in the plantation.

A list is given of more than 30 species of bromeliads found on the immortelles in cacao plantations, including 22 species in which larvae of *Anopheles (Kerteszia)* were found, and also a table showing the numbers of bromeliads on trees on different estates in the Tamana region. For the 50 trees involved, the average number of bromeliads per tree was 66 [but cf. also 25 107]. Five species were found in abundance on nearly all cacao estates, but observations on the incidence of larvae of *A. bellator* in different bromeliads and experiments in which different species were offered for oviposition in the same plot indicated definite selection on the part of the female mosquito, probably related to the water-holding capacity of the plant, the relative accessibility of the water surface and the coincidence or otherwise in the local distribution of plant and Anopheline. Only one species of bromeliad, *Gravisia aquilega*, which was the second in abundance, was found to be of outstanding importance. This species contained nearly five times as many larvae per tree as any other of ten studied, although one less abundant species showed more larvae per plant.

The distribution of the cacao-growing areas in Trinidad, and the relation between rainfall and spleen rates in school children in these areas are shown on maps. The highest spleen rates were from the north-central part of the island, where the annual rainfall was high (91-110 inches) and *A. bellator* the

only vector present. Counts of larvae from bromeliads on cacao estates in various parts of the island showed that *A. bellator* was scarce in zones of low rainfall.

Since adults of *A. bellator* rarely enter houses, the only practical means of control is the destruction of the bromeliads. Manual removal would be excessively costly, even if the control were restricted to *G. aquilega* and the two less common species resembling it, *Wittmackia lingulata* and *Hohenbergia stellata*, for the immortelles are dangerous to climb under any circumstances, and almost impossible after rain. Tests were therefore made with phytotoxic sprays, and it was found that copper sulphate gave the best results. Owing to the peculiar absorptive properties of their leaves, it was possible to destroy the epiphytes without harming the immortelles or the cacao trees. The spray was applied from the ground with equipment specially designed for use in forests, and it was thought that thoroughly sprayed areas would not need treating again for about five years. The authors stress, however, that the best long-term control measure would be the replacement of interplanted shade trees by windbreaks, as is done in some other cacao-growing areas. For this purpose, trees less prone to harbour bromeliads could be used, and conditions in the cacao plantations would at the same time become less favourable to the adults of *A. bellator*.

**Notes and Exhibitions** [presented at meetings of the Hawaiian Entomological Society in 1945].—*Proc. Hawaii. ent. Soc.* **12** no. 3 pp. 463–492, 1 ref. Honolulu, 1946.

The Encyrtid parasite of the oöthecae of *Supella supellectilium*, Serv., that was considered to be a species of *Metaphycus* [*R.A.E.*, B **33** 129] has been identified by Compere as *Comperia falsicornis*, Gomes, which was described from Brazil as a variety of *C. merceti*, Comp. [**31** 49].

A species of *Eurytoma* similar to *E. arachnovora*, Hesse, but distinct from it, the larvae of which feed on the eggs of *Latrodectus* within their cases, was reared from egg cases of *L. geometricus*, Koch, and *L. mactans*, F., on Oahu, *L. geometricus* on Kauai and *Latrodectus* sp. on Maui. The Scelionid parasite, *Baeus californicus*, Pierce, which was liberated on the island of Hawaii in 1939, was recovered from an egg case of *L. mactans* there in June 1945. Both females and males, which had not previously been seen in the Territory, were present. It is recorded that an egg case characteristic of *L. geometricus* produced by a spider collected on Oahu had the coloration typical of *L. mactans*. The young from it showed a wide variation in colour and markings.

WOOD (S. F.). **The Occurrence of *Trypanosoma conorhini* Donovan in the Reduviid Bug, *Triatoma rubrofasciata* (Degeer) from Oahu, T. H.**—*Proc. Hawaii. ent. Soc.* **12** no. 3 p. 651. Honolulu, 1946.

Two males and two females of *Triatoma rubrofasciata*, Deg., taken under a hen coop on Oahu on 27th March 1945 were dissected on 19th May after they had died. Both the females and one male showed typical crithidial and trypanoform stages of *Trypanosoma conorhini* [*cf. R.A.E.*, B **35** 124]. One male collected in a house on 24th May was heavily infected with the same parasite. Two adults and 19 nymphs from a house for cats in the Kaimuki district were negative, but a male and a female taken under a hen coop in the same general area were heavily infected. The structure of the parasites from stained smears and the characteristic motility of the trypanoform stages agree very closely with the crithidial and metacyclic trypanosome forms of *T. cruzi* harboured by other species of *Triatoma* in the United States.

MCQUEEN (D.). **Control of Red Mite on Poultry. Trial with DDT.**—*J. Dep. Agric. Vict.* **46** pt. 6 pp. 258–260. Melbourne, 1948. **Trials with DDT.**—*T. c.* pt. 7 p. 292.

In the first of these papers, the author describes an experiment in which DDT was applied to leave a toxic deposit for the control of red mite [*Dermanyssus gallinae*, Deg.] in fowl pens in Victoria. The larvae of this mite remain attached to the fowls for several days; nymphs and adults shelter in crevices of the pens or under piles of droppings and attack the birds at night. Sprays that kill by direct contact cannot, therefore, when applied to the perches, have any effect on the larvae on the fowls, nor can they reach the nymphs and adults unless the perches are so designed that they can be quickly dismantled and all crevices sprayed. Application of such sprays must in consequence be made frequently in order to effect satisfactory control. It was hoped that the DDT deposits would kill the larvae when they left the birds and that the nymphs and adults that were concealed in crevices when the spray was applied would be killed when they crawled out in search of hosts.

The tests were carried out on a detached row of five pens, each containing about 100 birds. The perch fittings were of the type most likely to harbour mites, and a heavy infestation had been allowed to develop. Three pens were sprayed with suspensions containing 0·1, 0·5 and 1·0 per cent. DDT, respectively, which were applied to the perch structures, after levering up the perches at each junction and scraping off the droppings, and also to the outside of the nest boxes and the lower parts of the walls. About 2–3 gals. spray were used for each pen. Observations made weekly for one month indicated that the 0·1 per cent. DDT spray was ineffective, but the other two gave promising control. The remaining pens were then treated, one with a 1·5 per cent. DDT suspension, the other with tar oil. Both treatments were applied to perch structures only, each perch being completely detached and nailed in again after treatment. Observations after a further month showed no apparent infestation in any of the DDT-treated pens, except that which received the 0·5 per cent. spray where two mites were found. Several clusters of engorged mites were found in the pen painted with tar oil. The control exercised by 0·1 per cent. DDT after two months was thought to indicate that this concentration affected immature stages more than adults, leading to a gradual diminution in population.

In the second paper the author reports on a further examination of the pens, made 12 weeks after the last observation. No mites were found at the perch junctions in pens treated with 0·5–1·5 per cent. DDT suspensions, but heavy infestations of engorged mites were observed at most of the perch junctions in the pen treated with tar oil and fairly heavy ones in that treated with 0·1 per cent. DDT.

WATERHOUSE (D. F.). **The relative Importance of live Sheep and of Carrion as Breeding Grounds for the Australian Sheep Blowfly *Lucilia cuprina*.**—*Bull. Coun. sci. industr. Res. Aust.* no. 217, 31 pp., 2 pls., 3 figs., 22 refs. Melbourne, 1947.

Earlier observations showed that most of the infestation of sheep by blowflies in Australia is initiated by *Lucilia cuprina*, Wied. [*R.A.E.*, B **26** 81–82; **33** 51] and indicated that few adults of this species emerge from carrion and that attempts to control it should be directed against breeding in sheep. An account is given of experiments undertaken to confirm and extend these observations and to provide a firmer base for the control policy that had been

recommended. They showed that the high temperatures generated by the activity of the maggots in a carcass were apparently a major factor in limiting the production of adult flies.

Sheep carcasses were exposed at Canberra monthly or fortnightly from June 1940 to July 1941 and three times in February 1942 on a layer of sand 6 ins. deep in large trays from which maggots were prevented from escaping by incurving the sides. The emerging flies were trapped, and counts were made of the numbers and species produced. Only six carcasses out of 27 exposed under these conditions yielded *L. cuprina*, with an average of four per animal exposed; the number of all flies produced per carcass varied from 109 to 66,979 with an average of 10,000. As it became evident that predators were killing more larvae than might be expected in the field because they were hindered from departing by the construction of the tray, 11 carcasses were exposed in turn between November 1940 and February 1942 on a thin layer of sand on a flat tray surrounded by a maggot-proof gutter, from which the fully fed larvae fell into a jar. The trays were protected from rain and direct sunlight. Larvae were collected frequently from the jars, the predators removed, and the larvae put in trays to pupate. Those of *Chrysomyia rufifacies*, Macq., which are predacious, were segregated as far as possible. These carcasses all produced some adults of *L. cuprina* with an average of 304 per animal. Many more primary flies (*Lucilia* and *Calliphora*) were produced by carcasses on the flat trays than by those in the deep trays. This is shown to be largely due to the absence of predacious beetles.

During the warmer months, there was intense competition for food and space [cf. 22 261], so that many larvae were driven from the carcass or killed by predacious *Chrysomyia* larvae. Although *L. cuprina* has the advantage of arriving early at a fresh carcass, it meets competition from *Calliphora augur*, F., in spring and autumn, and from *Chrysomyia rufifacies* and other secondary flies in the warm weather. Many larvae are also killed by the high temperature generated in the carcasses as a result of their activity. Temperature conditions in a carcass and in a strike wound during larval development are discussed [cf. 28 241]. Temperature and mortality in a carcass vary directly with the degree of overcrowding, and though females of *L. cuprina* may be seen ovipositing on carcasses, competition and high temperature (often in the region of 115°F.) prevent all but a few larvae from completing their development. A large proportion of the surviving larvae may be devoured by predators, and half of those that escape and leave the carcass fail to produce adults, probably as a secondary result of the temperatures met with in the carcass during larval development. Preliminary evidence suggests that secondary larvae may be more resistant to high temperature than primary ones. The carcasses of smaller animals (lambs, hares, birds, lizards) were no more effective in producing *L. cuprina* than the sheep carcasses, though temperatures in them did not rise nearly so much. Several carcasses exposed at Cunnamulla, south-western Queensland, produced results similar to those exposed in Canberra.

A comparison of the catches of *L. cuprina* in a trap over the experimental period with the average catch for a number of years indicated that carcasses were exposed under conditions more than usually favourable for this species. The high incidence of strike in the experimental flock confirmed this.

From 26 struck sheep placed in separate cubicles in an insectary, an average of 1,220 adults of *L. cuprina* per strike was bred. This species formed 90 per cent. of the flies produced. It does not meet with the amount of competition on the living sheep that occurs in carcasses [cf. 33 181], temperatures are more favourable (usually remaining at 102–105°F.) and the larvae can escape to the cooler fleece and obtain nourishment there from exudate, and attack by predators is non-existent or unimportant. As one means of testing the conclusion that the living sheep is a far more important breeding ground for

*L. cuprina* than carcasses, a trapping experiment was carried out in 1942 in an area of New South Wales in which very few sheep were present. A few adults of *L. cuprina* were caught, but it was estimated that twenty times as many would have been taken under similar conditions in Canberra.

Finally, the implications of these findings in relation to the measures to be adopted to lower the population of *L. cuprina* are discussed. Burying carcasses without first applying poison is harmful and efficient disposal unwarranted [cf. 20 259-260]. All larvae removed from strikes should be destroyed and the wounds dressed to kill those remaining [33 50-52]. In addition to direct measures, any methods of lowering the susceptibility of sheep to attack should incidentally lower the population of *L. cuprina*.

WATERHOUSE (D. F.). **Studies of the Physiology and Toxicology of Blowflies.** 12. **The Toxicity of DDT as a Contact and Stomach Poison for Larvae of *Lucilia cuprina*.** 13. **Insectary Tests of Repellents for the Australian Sheep Blowfly *Lucilia cuprina*.**—*Bull. Coun. sci. industr. Res. Aust.* no. 218, 30 pp., 4 graphs, 22 refs. Melbourne, 1947.

In the first of these papers an account is given of laboratory experiments for the purpose of obtaining further information on the contact and stomach toxicity of DDT to larvae of the sheep blowfly, *Lucilia cuprina*, Wied. [cf. *R.A.E.*, B 35 103, 165]. In tests of contact toxicity of liquids, recently formed prepupae were immersed for  $\frac{1}{2}$  or 5 minutes and were then placed on dry, sieved sand in jars and kept until all adults had emerged. In the case of dry materials, prepupae were placed in jars containing a half-inch layer of test material and left until pupation and emergence had occurred. In this case, recently formed prepupae were compared with those almost ready to pupate. Immersion in emulsified solutions of DDT in dimethyl phthalate, dibutyl phthalate or solvent naphtha or in DDT suspensions produced no appreciable effect. Solutions of DDT in alcohol or kerosene, particularly the latter, caused some mortality, although not much more than the solvents alone, but there was a high mortality among the young prepupae allowed to complete their development in pure DDT powder or in 1-10 per cent. DDT on pyrophyllite. When they were left for up to one hour and then removed, few failed to produce adults. When the older prepupae were used, mortality was low, and this was attributed to changes in the permeability of the larval cuticle. Emergence was recorded when the fly had begun to climb out of the puparium, although sometimes the process was not completed and some flies died subsequently, probably from contact with DDT remaining on the outside of the puparium. In general, all insects which managed to pupate also emerged, indicating that there were no delayed toxic effects.

Stomach poison tests were carried out on larvae reared in an artificial medium [cf. 28 57] through which varying amounts of DDT were distributed as evenly as possible. Surface-sterilised eggs were placed in lots of 50 in bottles of the medium, and the effect of the poison was assessed on the basis of retardation of growth [29 102], calculated from the average body weight of larvae after various intervals. The DDT was applied in a variety of forms, and comparisons were also made with p,p'-dichlorodiphenyldichlorethylene (DDY), a breakdown product of DDT. Results are shown graphically or in tables. A concentration of 0.01 per cent. DDT in the medium retarded growth to about half size, while 0.03 per cent. inhibited it completely. This influence was intensified by a decrease in the nutritive properties of the medium [cf. 28 57], but larval resistance was increased with increasing body weight and older larvae transferred from control to poisoned media were less severely affected than young ones. The impregnated media had no effect on the hatching of eggs, and a high proportion of the larvae which managed to pupate gave rise to adults

[but cf. 35 104]. No symptoms of distress of the nervous system were observed in affected larvae. The tests with DDY indicated that it was less toxic than DDT at high concentrations (0.1 and 0.05 per cent.) and about equally toxic at low concentrations (0.01 and 0.005 per cent.)

In the second paper, the author describes tests of various essential oils and other materials, carried out mainly in 1941-42, to assess their efficiency in preventing oviposition by *L. cuprina*. The test materials in paraffin oil were applied in rings round cotton-wool plugs soaked in an attractive solution and tied in the fleece on the backs of sheep and the animals were exposed in a large insectary to a dense population of blowflies of which the females were ready to lay eggs. Control plugs were ringed with medicinal paraffin oil, which exerted a slight repellent effect. The plugs were removed after 5-6 hours and the number of separate egg batches estimated. Full results are shown in tables. The repellent effect of Ceylon citronella oil [29 50; 33 182] was confirmed, but Java citronella oil was not repellent. Of the four fractions into which Ceylon citronella oil was divided at reduced pressure, the first, third and fourth were not repellent, while the second had a repellency equal to that of the whole oil. A reconstituted oil, blended from the four fractions in the proportions in which they were produced, approached the whole oil in repellency. Two-thirds of the second fraction consisted of a mixture of 70 per cent. geraniol and 30 per cent. citronellal. Geraniol has been shown to exert no repellency, while citronellal was attractive, as was also a 70:30 geraniol-citronellal mixture. The remainder of the second fraction was highly repellent, but the identity of the constituents is unknown. The oils of *Zieria smithii* and *Dacrydium franklinii* [cf. 36 197] were repellent, while oils from the leaf and wood of *Callitris glauca* were ineffective. Of five *Eucalyptus* oils, three were not repellent and two were attractive. Other oils that were not repellent were *Melaleuca linariifolia*, *M. ericifolia*, *Eremophila mitchelli*, *Tagetes glandulifera*, *T. minima* [cf. 25 245] and camphor oil. Chemically pure oleic acid was repellent [cf. 29 101], but a commercial grade was not. Two materials containing Indalone were effective repellents, as were also dimethyl phthalate and 612 (2-ethylhexanediol-1,3) [cf. 36 197].

KNAPP (R. B.) & AANESTAD (A.). **Summer Fly Spraying with DDT controls Cattle Lice.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* 9 no. 4 p. 119. Fargo, N. Dak., 1947.

A survey in February 1947 on 18 farms in Cass County, North Dakota, on which barns and animals had been sprayed with DDT suspension in the previous summer for the control of flies [cf. next abstract] showed that although the young cattle that had been in the pasture when the barns were sprayed were infested by lice, including *Damalinia (Bovicola) bovis*, L., and *Linognathus vituli*, L., the older animals were free from infestation. Most of the cattle on 17 farms on which DDT had not been used showed light to heavy infestations and required treatment.

MUNRO (J. A.), POST (R. L.) & COLBERG (W.). **The new Insecticides in Fly Control.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* 9 no. 5 pp. 123-128, 1 ref. Fargo, N. Dak., 1947.

During the summer of 1946, sprays containing 1 lb. actual DDT, DDD (dichlordiphenyldichlorethane) or BHC (benzene hexachloride) per 25 U.S. gals. were tested for the control of flies in farm buildings and on livestock in North Dakota. The materials used were emulsion concentrates containing 20 and 25 per cent. DDT and 25 per cent. DDD, called Gesarol, Deenate 25-R and Rhothane, respectively, and wettable powders containing 50 per cent. benzene

hexachloride, DDT or DDD, the last two called Deenate 50-W and Rhothane WP-50. The sprays were applied at a pressure of 150 lb. to all the interior surfaces of the buildings and the outside walls to a height of 7 ft. Three collecting surfaces of one square yard were installed near the windows in each barn, and dead flies removed from them and counted periodically. The numbers did not show the comparative effectiveness of the insecticides, because flies were more abundant in some barns than others. Fly counts on livestock represented the number of flies on one side at any time. The numbers of dead flies (*Musca domestica*, L., and *Stomoxys calcitrans*, L.) per three square yards following spraying of barns on 19th July and 18th August 1946 are given for 11 days between 20th July and 23rd September for the various preparations; the Rhothane emulsion was applied only on 15th August, and the figures for Deenate 25-R on two of the intermediate dates are lacking. The figures for the first and last days and the maximum taken on any one day, with the date shown in brackets, were 13, 24 and 103 (29th July) for Gesarol applied in a sheep barn, 167, 39 and 1,243 (29th July) for BHC in a pig barn, 36, 40 and 218 (29th July) for Rhothane WP-50 in a beef barn, 4, 68 and 145 (26th August) for Deenate 25-R in a bull barn, 60, 227 and 301 (26th August) for Deenate 50-W in a dairy barn and 178, 88 and 178 (on 26th August) for Rhothane emulsion applied to sheep pens in August only. The percentage of *S. calcitrans* in the various barns ranged from 8.9 to 41.7.

BHC gave the most spectacular results, as it was applied in the barn that had the most flies before treatment and reduced the numbers to less than those in the other barns, but it would not be suitable for use in dairy barns or near food products on account of its objectionable odour. It could, however, be used to advantage in pig, beef and sheep barns or round garbage dumps. On 29th August, 17 pigs and their pens were thoroughly drenched with the BHC spray and the pigs apparently suffered no ill effects apart from the possible loss of some hair. The average numbers of flies per pig were 23 before the treatment, 7, 2 and 3 two, three and four days after it, and 1.75 two weeks later, when the average was 11 on untreated animals on a neighbouring farm. The number of flies on the sides and ceiling of a pen was reduced from 10 before treatment to 4, 3 and 2, two, three and four days after it. Two weeks later, there was an average of 3 flies per pen, while a comparable area of an untreated pig barn had 86 flies resting on it. Six beef bulls thoroughly sprayed on 29th August had averages of 36 flies per animal before treatment and 15, 13 and 16 two, three and four days after it, and suffered no apparent ill effects.

Treatment of a herd of 20 beef cattle with 20 U.S. gals. DDD emulsion reduced the number of flies per animal from 75-100 to one, three days later, when an untreated herd showed an average of 62 flies per animal. In the tests of the DDD wettable powder, 34 steers and heifers that had an average of 40 biting flies on the shoulders and lower parts of the legs before receiving 22 U.S. gals. spray had 6.5, 1.25, and 5 two, three and four days, respectively, after treatment. Biting flies were abundant on 29th August on beef bulls that had been sprayed on 15th.

Dairy cattle coming in from pasture on 29th August showed an average of 12-15 flies, and there were 9 flies per cow near the doors and passageways and 1-3 in the interior of the dairy barn. The cows were sprayed with DDT wettable powder after milking, 42 U.S. gals. spray being used on 37 animals, and two days later they showed an average of 6-7 flies when coming from pasture and one fly during milking. There were very few flies on the cows coming in three days later, when it was cloudy and cold, and none was seen on the cows being milked in the feeding lanes, whereas on the same day, there were 10 flies per cow on an unsprayed herd. Before the use of the DDT spray, fly spray had to be applied to the cows each day before milking, but it was not needed afterwards.

It is concluded that for the control of *M. domestica* and *S. calcitrans* in North Dakota, spraying should begin in late June or early July. An additional application is needed in about five weeks for buildings. More frequent applications may be necessary for livestock. At the concentrations used, the sprays caused no apparent injury to the animals.

GROVE (J. F.) & BOVINGDON (H. H. S.). **Thiocyanate Insecticides : the Relation between knock-down Activity and chemical Constitution.**—*Ann. appl. Biol.* **34** no. 1 pp.113-126, 32 refs. London, 1947.

A range of 27 aliphatic and cyclic thiocyanoacetates ( $R.O.CO.CH_2.SCN$ ) was prepared, their knockdown activity in sprays against *Musca domestica*, L., was evaluated, and the irritant effects of the spray mists on the eyes and nose were noted. It is concluded from the results, which are given in tables, that the most effective (n-hexyl thiocyanoacetate and cyclohexyl thiocyanoacetate) are too irritant for them to be used in domestic fly-sprays. Saturated compounds, whether aliphatic or cyclic, are more active than the corresponding aromatic compounds with the same number of carbon atoms. In the aliphatic and alicyclic series, the irritant effect on the mucous membranes decreases regularly with increasing molecular weight; R- must contain not less than ten carbon atoms before a solution containing 1 per cent. thiocyanoacetate becomes non-irritant to the human eyes and nose. Some compounds derived from saturated alcohols containing ten carbon atoms had no irritant effect and showed moderately high activity at a concentration of 1 per cent. These were carvomenthyl thiocyanoacetate, Thanite (stated to contain 96 per cent. isobornyl thiocyanoacetate) and fenchyl thiocyanoacetate [*cf. R.A.E.*, B **36** 165]. Since the knockdown activity of alkyl thiocyanates is low, the -SCN radical is not the only cause of activity in thiocyanoacetates, and if the radical R causes the molecule as a whole to be soluble in lipoids, the ester ketomethylene linkage between the hydrocarbon and -SCN radicals must be responsible in part for the activity. A series of seven  $\alpha$ -thiocyanoketones of general formula  $R.CO.CH_2.SCN$  was accordingly tested. Several were more active than the corresponding thiocyanoacetates but were also more irritant and so could not be used in domestic fly-sprays. This seemed to indicate that activity might be connected with the degree of enolisation of the ketomethylene group, but three compounds in which the -SCN radical was attached directly to an ethylene double bond were completely inactive. Two hydroxythiazones prepared from the two most active  $\alpha$ -thiocyanoketones were also without knockdown activity. It is therefore concluded that linkage of the toxic thiocyanate radical through a ketomethylene group to a lipid-soluble hydrocarbon residue gives rise to knockdown activity.

The ways in which the compounds tested were prepared are described, their formulae and properties are given in tables, and their mode of action is discussed.

FREAR (D. E. H.). **A Catalogue of Insecticides and Fungicides. Volume II. Chemical Fungicides and Plant Insecticides.**—*Ann. cryptog. phytopath.* **8** xii+153 pp., frontis., 5½ pp. refs. Waltham, Mass., Chronica Botanica Co.; London, Wm. Dawson & Sons, Ltd., 1948. Price \$5.50 or 33s.

The data in this second volume are presented in the same way as those in the first [*R.A.E.*, B **36** 149]; it contains the sections on fungicides and one on plant insecticides, and an alphabetical index to all the chemical compounds dealt with in the two volumes. The introductory chapter explaining the coding system, which is adopted for the chemical fungicides, is repeated; the plant insecticides are recorded under the plants in alphabetical order, but

the information on particular plant products, such as nicotine or rotenone, is given in the first volume.

ALSTERLUND (J.). **RHothane D-3 in the Pest Control Field.**—*Pests* **14** no. 5 p. 10. Kansas City, Mo., 1946.

DDD (dichlordiphenyldichlorethane), which is marketed commercially under the name RHothane D-3, resembles DDT in its physical characteristics and is considered to be of the same order of toxicity to insects. In tests by the Peet-Grady method, 0.5 per cent. DDD gave approximately complete kill of houseflies [*Musca domestica*, L.] when combined with a suitable knockdown agent, and 1–2 per cent. in mineral oil was as effective against German and American cockroaches [*Blattella germanica*, L., and *Periplaneta americana*, L.] as the Official Test Insecticide. However, both DDD and DDT, as spray or powders, are considered too slow in their action against cockroaches to be of adequate practical value. Dusts containing DDD proved toxic to fleas, and DDD was found fully as effective as DDT in direct-contact sprays against bed-bugs [*Cimex lectularius*, L.]. Investigations carried on for over a year indicated that its toxicity to warm-blooded animals ranged from 25 to 10 per cent. of that of DDT [cf. *R.A.E.*, B **35** 193].

DONOHUE (H. C.), KING (D. D.) & GALL (C. M.). **Notes on Laboratory Methods.**—*Pests* **14** no. 5 pp. 20, 22, 24, 6 figs., 1 ref. Kansas City, Mo., 1946.

Descriptions are given of the methods used by a firm of household insecticide manufacturers for rearing cockroaches and testing insecticidal powders on them in the laboratory. The rearing technique differs only in minor details from those already described [cf. *R.A.E.*, B **36** 187], but since the American cockroach [*Periplaneta americana*, L.], the main test species employed, reacts unfavourably to dirty or overcrowded conditions, which tend to cause high mortality and to lessen resistance under test, particular attention is paid to cleanliness and space. Every rearing jar is provided with a "dispersal ladder" consisting of a strip of hardware cloth (3–4 meshes per inch) forming an archway, on which the insects spend the greater part of the time. These ladders increase the available surface area, very few metabolic by-products adhere to them, and they permit the free passage of air. Under these conditions, the average duration of the nymphal period of *P. americana* was not more than nine months [cf. **29** 55]. The German cockroach [*Blattella germanica*, L.] was found to react so unfavourably to them, however, that satisfactory colonies could not be maintained; it appeared that this species developed best under filthy and crowded conditions. *Supella supellecilium*, Serv., thrived, but was exceedingly sensitive to the low week-end temperatures that occurred as a result of fuel economy.

In devising methods of testing insecticidal powders, care was taken to approximate as closely as possible to the actual conditions of use, and all comparative tests were made on a volume basis, since in practice a given quantity of insecticide is usually laid down, regardless of its density. The authors consider that the usual settling tower [cf. **31** 165] and walk tests provide highly unnatural conditions in that, in the former, the insects are exposed without any possibility of avoiding the insecticide and, in the latter, they are often so disturbed that they act in a manner far removed from their naturally cautious behaviour and consequently pick up an abnormal amount of insecticide. Two modifications of the walk test are described. In the first, a plywood disk 7½ inches in diameter is covered by a plywood ring and a disk that mask the outer ¾ in. and the centre, respectively. The width of the area between these, on which a measured volume of 6 cc. of test powder

is evenly sprinkled from a salt shaker, can be varied by using appropriate central disks ; the standard width of band used was  $1\frac{1}{2}$  ins. The masks are then removed and the central one replaced by a clean paper disk, on which is placed a glass cylinder. The whole unit is placed in a 9-inch crystallisation dish, the inner walls of both dish and cylinder being oiled to prevent the insects escaping. Five well-grown nymphs of *P. americana* or 10–15 of *B. germanica* of assorted ages are placed in the cylinder, and this is removed when they have become quiet. The insects are gently guided, by means of a small bristle brush, across the treated band and off the disk into the dish, the crossing normally taking place in a typically cautious fashion. The disk is removed as soon as all have left it, and any stray particles of powder are at once wiped from the dish with cottonwool. The cockroaches are left in the dish for observation, food being supplied and water added, usually daily, by sprinkling the bottom.

The second method is of the multiple-crossing type and involves the use of a shallow box, 3 ft. square, with screened sides and lid and an inner plastic wall  $2\frac{1}{2}$  ins. high, coated with a film of mineral oil to prevent the cockroaches from mounting the sides. A total of 6 cc. insecticide is shaken out in bands, approximately one inch wide and six inches long, at chosen areas on the floor. As in the previous test the cockroaches are allowed to escape from a cylinder placed in the centre of the box. They crawl about naturally, and, unless the powder is repellent, they may cross the bands repeatedly. This method simulates conditions in houses where bands of insecticide are spread in front of hiding places and across areas over which cockroaches forage. A powder that is not sufficiently toxic to kill as a result of a single crossing may thus be highly effective in practice, as a result of repeated crossings. Variations in season, temperature, humidity and unknown ecological factors that appeared to influence the results from other tests did not affect those of tests by the box method.

SMITH (C. N.). **Biology of *Ixodes dentatus* Neumann (Ixodidae).**—*Ann. ent. Soc. Amer.* **38** no. 2 pp. 223–233, 3 refs. Columbus, Ohio, 1945.

Experimental studies on the biology of the tick, *Ixodes dentatus*, Marx, were begun at Vineyard Haven, Massachusetts, in June 1938 with examples of all stages collected in nature or reared in the laboratory, information on its life-history being obtained under various conditions both indoors and outdoors. Records of the duration of the various stages, engorgement and oviposition are given in tables, and seasonal activity and adult habits are discussed. Cottontail rabbits [*Sylvilagus*] were found to be almost its only hosts [*cf. R.A.E.*, B **32** 45], many of those captured being heavily infested and few entirely free from ticks. A few examples of *I. dentatus* were found on three musk-rats [*Ondatra zibethica*] and a brown thrasher [*Toxostoma rufum*]; none was found on the numerous other rodents examined or on dogs. One of 46 nymphs taken on a rabbit was parasitised by *Ixodiphagus texanus*, How., which is normally a parasite of *Haemaphysalis leporis-palustris*, Pack. [*cf. 32* 44].

NICHOLSON (H. P.). **The Morphology of the Mouthparts of the non-biting Blackfly, *Eusimulium dacotense* D. & S., as compared with those of the biting Species, *Simulium venustum* Say (Diptera : Simuliidae).**—*Ann. ent. Soc. Amer.* **38** no. 2 pp. 281–297, 25 figs., 15 refs. Columbus, Ohio, 1945.

It has long been suspected that some species of Simuliids do not feed on blood since they have never been observed to bite. The author shows, from a study of the formation of its mouth-parts, that *Simulium* (*Eusimulium*) *dacotense*, D. & S., of which *S. (E.) lascivum*, Twinn [*cf. R.A.E.*, B **31** 184] is stated to be a synonym, is in fact incapable of biting, the mandibles of the female resembling those of the male, being thin and almost membranous and the

maxillae weakly sclerotised and armed only with long setae. The mouth-parts of both sexes of *S. dacotense* are described and figured, and are compared with those of the female of *S. venustum*, Say, a species known in the United States for the severity of its attacks, and a brief account is given of the bionomics of the former in Minnesota.

TURNER (J. G. S.). **Mosquito Control.**—*Rep. med. Dep. Gold Coast 1945* pp. 12–13. Accra, 1946.

During 1945 an extensive experiment was carried out at Takoradi in the Gold Coast to ascertain whether the routine twice-weekly spraying of houses with pyrethrum extract in kerosene [*cf.* R. 4.E., B 33 201] could with advantage be replaced by spraying with DDT to leave a lasting toxic deposit [34 92]. A 1 per cent. solution of DDT used to give a calculated deposit of 38.5 mg. DDT per square foot resulted in a relative absence of mosquitos during 18 weeks. During the first nine weeks, the proportion between mosquitos in treated and untreated rooms rose gradually to 1 : 4. When the dosage was reduced to 11.9 mg. per sq. ft., the proportion 1 : 4 was reached in 11 days, and complete parity with the controls ensued in four weeks. It was concluded that the 1 per cent. solution in a dosage approximating to 20 mg. DDT per sq. ft. would afford reasonable protection for at least two months, and arrangements were made to adopt this treatment in all African dwellings in the Takoradi township and village areas.

LAIRD (M.). **A Report on Material obtained during a Mosquito Survey at Palmalmal, New Britain, July–October, 1945.**—*Trans. roy. Soc. N.Z.* 75 pt. 4 pp. 465–478, 19 refs. Wellington, N.Z., 1946.

Notes are given on the prevalence and breeding places of 37 species of mosquitos taken in coastal coconut plantations and bordering second-growth jungle and rain forest in the neighbourhood of Palmalmal, Jacquinot Bay, New Britain, between 4th July and 26th October, 1945. Twelve species, including two undescribed ones, are recorded from the island for the first time, and the others include all but eight of those previously recorded there; a list of the latter is given. The average annual rainfall at Palmalmal for six years was 205.27 ins. The genus *Anopheles* was represented by *A. punctulatus*, Dön., immature stages of which were common in temporary sunlit collections of clear water devoid of macroflora, and *A. farauti*, Lav. (*punctulatus moluccensis*, Sw. & Sw.), which bred in clear or foul water exposed to sunlight but with shade and shelter available from emergent grasses, floating leaves and algae. Large larvae of *A. punctulatus* were observed to prey on newly hatched ones of their own species in the laboratory. Malaria was endemic among the native population at Jacquinot Bay. *Aedes aegypti*, L., was seldom seen, and dengue fever was not reported from the area.

#### PAPERS NOTICED BY TITLE ONLY.

RICHINS (C. A.). **The Development of the Midgut in the Larva of *Aedes dorsalis* Meigen.**—*Ann. ent. Soc. Amer.* 38 no. 3 pp. 314–320, 5 figs., 7 refs. Columbus, Ohio, 1945.

YEAGER (J. F.) & MUNSON (S. C.). **The Relation between Poison Concentration and Survival Time of Roaches [*Periplaneta americana*, L., and *Blatta orientalis*, L.] injected with Sodium Metarsenite.**—*Ann. ent. Soc. Amer.* 38 no. 4 pp. 559–600, 5 figs., 15 refs. Columbus, Ohio, 1945. [*Cf.* R.A.E., B 33 25.]

PIÉDROLA GIL (G.). **Recientes adquisiciones y técnicas de empleo del D.D.T.** [Recent Information concerning DDT and its Uses.]—xi+307 pp., 26 pls. (54 figs.), many refs. Madrid, Inst. esp. Med. colon., 1948. Price 100 *ptas*.

This book is based substantially on the sections dealing with DDT in an earlier work by the author [*R.A.E.*, B 36 26], but the information in them has been considerably amplified and brought up to date. It is divided into chapters dealing with the nature and chemical properties of DDT, its mode of action on insects and the symptoms produced in them, methods of analysis, and the ways in which it is employed against Arthropods of medical and veterinary importance and pests of crops and stored products. A short section is included on the impregnation of textiles and paper. Recent Spanish legislation on the sale and use of DDT and some other contact insecticides with special reference to the control of flies is given in an appendix.

NÁJERA ANGULO (L.). **La lucha contra las moscas.** [The Control of Flies.]—204 pp., 22 pls., 14 figs., 18½ pp. refs. Madrid, Direcc. gen. Sanid., 1947.

This book, which is based very largely on the literature, is divided into five chapters.

The relation between man and flies is traced from early times in the first, and their importance in the propagation of disease and in causing myiasis in man and animals is reviewed in the second. The third contains a summary of the taxonomy of Diptera, a discussion as to what species are to be classed as "domestic" flies and accounts of the bionomics of the members of this group that are of importance in Madrid, which include as the commonest *Musca domestica*, L., *Fannia canicularis*, L., *Stomoxys calcitrans*, L., *Muscina stabulans*, Fall., and blowflies. The fourth and fifth chapters deal with sanitary measures and methods of control and with the organisation of campaigns against domestic species. The author considers that control by means of the proper disposal of manure to prevent breeding is the most advantageous method for use in Spain.

**DDT and other Insecticides and Repellents developed for the Armed Forces.**—*Misc. Publ. U.S. Dep. Agric.* no. 606, 71 pp., 27 figs., 22 refs. Washington, D.C., 1946.

This publication contains the results of three years' intensive investigations at the Orlando, Florida, laboratory of the Bureau of Entomology and Plant Quarantine together with some data from other sources. Although the recommendations made were originally issued in mimeographed form for use in occupied territories in wartime, the materials and methods are applicable, with only slight modification, for both military and civilian use under peacetime conditions. Data on the history, preparation and properties of DDT, methods of analysing it, and the preparation of solutions, emulsified solutions, suspensions and dusts of it are first given, together with brief notes on benzene hexachloride, Rutgers 612 (2-ethylhexanediol-1,3), Indalone (n-butyl mesityl oxide oxalate), dimethyl phthalate and benzyl benzoate, lists of emulsifiers for the last two and lists of repellents and DDT preparations issued to the United States armed services.

Recommendations follow for the application from the ground of DDT in solutions, emulsified solutions and dusts for the control of larvae of Anophelines and certain other mosquitos, and of DDT insecticides as sprays to leave a toxic residue or as liquefied gas aerosols or concentrated sprays against adult mosquitos indoors or in outdoor resting places; for the application of DDT from the air against Anopheline larvae and adults (including descriptions of equipment used with slow-flying aircraft, and methods of estimating effectiveness); and for the use of DDT for the control of *Musca domestica*, L., and

blowflies in buildings, DDT and paradichlorbenzene to control fly larvae in pit latrines, DDT, benzene hexachloride and other substances to prevent blowfly breeding in corpses, and DDT to control *Cimex lectularius*, L., *C. hemipterus*, F., fleas, cockroaches, *Phlebotomus* spp., and *Culicoides* spp.

Directions are given for applying MYL (0.2 per cent. by weight pyrethrins, 2 per cent. N-isobutylundecylamide, 2 per cent. 2, 4-dinitroanisole and 0.25 per cent. Phenol S in pyrophyllite) or DDT powder (which is more effective) to clothing and body against *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) and *Phthirus pubis*, L., and to the hair to control *Pediculus humanus capitis*, Deg. (*P. h. humanus*, auct.), for impregnating garments with DDT to control *P. h. humanus* and for applying NBIN as a spray or with a sponge to the body or head hairs against all three lice and to the whole of the body against the scabies mite, *Sarcoptes scabiei*, Deg. (*S. s. hominis*, Hering). NBIN is a concentrate consisting of 68 per cent. by weight benzyl benzoate, 6 per cent. DDT, 12 per cent. benzocaine (ethyl *p*-aminobenzoate) and 14 per cent. Tween 80 and is diluted in five volumes of water for application. It is more effective against *S. scabiei* than benzyl benzoate alone, probably owing to the action of the benzocaine [*R.A.E.*, B 35 188], though the latter was included primarily as an ovicide and also alleviates the irritation caused by lice or scabies.

In a section on the use of repellents (dimethyl phthalate, 2-ethylhexanediol-1,3, Indalone and mixtures of the three in the proportions of 6-2-2 or 1-1-1) against mosquitos and other insects, information is given on the application of liquids to the skin by hand and to the clothing by hand or from sprayers, on the impregnation of clothing with solutions of the repellents in a volatile solvent or in emulsions and on the conditions under which repellents should be used. A section on protective measures against Trombiculid mites comprises a discussion of the relative merits of dimethyl phthalate, dibutyl phthalate and benzyl benzoate as repellents and acaricides, and their application to the clothing by the barrier method (liberal application to openings), smearing by hand, spraying or impregnation. Of acaricides tested for treating restricted areas in which the mites are breeding, benzene hexachloride has been the most promising.

The final section is by the late H. O. Calvery and P. A. Neal, and in it they deal briefly with the toxicity to mammals of DDT and the solvents, emulsifiers and other substances mentioned in the report.

SERGEANT (ED.), DONATIEN (A.), PARROT (L.) & LESTOQUARD (F.). **Etudes sur les piroplasmoses bovines.**—9½×6 ins., 816 pp., 325 figs., many refs. Algiers, Inst. Pasteur Algérie, 1945.

One of the chief hindrances to the development of cattle-rearing in French North Africa (Algeria, Morocco and Tunisia) is the prevalence of diseases of the piroplasmosis group; *Piroplasma bigeminum*, *P. (Babesiella) berberum*, *Theileria annulata (dispar)* and *T. mutans*, which is not pathogenic, occur in cattle all over the area and *Anaplasma marginale* is widespread in Algeria. An analysis of nearly 4,000 cases of piroplasmosis diagnosed in the laboratory in 22 years showed that these five parasites were responsible for 2.9, 28.8, 54, 3.6 and 10.6 per cent. of them, respectively. *T. annulata* is particularly virulent for European animals imported to improve the stock. All, with the possible exception of *A. marginale*, are carried by ticks. They have been studied at the Pasteur Institute of Algeria since 1913, and this monograph comprises the results of 30 years' work, some but not all of which have been published elsewhere.

The first of the four parts into which the book is divided concerns the classification of the parasites, the relative prevalence of the five occurring in

French North Africa, the seasonal distribution of the diseases, and the classification and identification of the ticks occurring on bovines in the area and their bionomics and seasonal distribution. The second part has a chapter on technique and also one on each of the infections, including discussions on the isolation of the parasites, pathology, diagnosis, clinical data, treatment, immunology and epizootiology and accounts of comparative experiments on these parasites and related species from other countries. The subject of the third part is the methods of vaccination that have been developed [R.A.E., B 16 163, etc.; cf. also 21 32] and methods of controlling ticks and protecting domestic animals from them; and in the fourth the authors deal with questions of comparative and general pathology arising out of the study.

The ticks commonly found on cattle in North Africa [cf. 17 17; 25 278-279] are *Ixodes ricinus*, L., three species of *Hyalomma*, *Boophilus calcaratus*, Bir., *Rhipicephalus sanguineus*, Latr., *R. bursa*, C. & F., and *Haemaphysalis cinnabarinata punctata*, C. & F. Accounts are given of experiments in which it was shown that *P. bigeminum* can be transmitted by *R. bursa* [17 97; 19 158] and by larvae of *B. calcaratus* bred from an infected female, *P. berberum* by *Boophilus calcaratus* [17 97] and by adults of *R. bursa* infected in the larval-nymphal stage, *T. annulata* by *Hyalomma mauritanicum*, Senevet [20 43, etc.], and *Anaplasma marginale* possibly by *H. lusitanicum*, Koch, and by interrupted feeding of *R. bursa* [17 97] and *B. calcaratus*. Negative experiments with *T. annulata* and a mosquito [30 148] and other ticks [16 267], with *T. mutans* and *Hyalomma mauritanicum* and *R. bursa*, and with *Anaplasma marginale* and *H. mauritanicum* and *Stomoxys calcitrans*, L., are also described, as is the development of *T. annulata* in *H. mauritanicum* [24 156, 246]. It is stated that *P. bigeminum* is carried through the winter in cattle and in ticks (*R. bursa*), *P. berberum* is maintained in cattle and has been shown to persist in adults of *R. bursa* nine months after the nymphs acquired the infection, and *T. annulata* is maintained in cattle cured of clinical symptoms (in which it possibly persists throughout life) and to some extent in *H. mauritanicum*, in which it is preserved from one year to the next but not from one generation to another.

The methods discussed for protecting cattle are quarantining newly acquired stock, choosing tick-free pasture, rotating pastures, using sheds alternately for cattle and horses as a protection against transmission of *T. annulata* by *H. mauritanicum* [17 17] but not of *P. bigeminum* by *R. bursa* [19 158], and constructing sheds free of crevices for protection against *H. mauritanicum*. The construction of tick-proof stalls is briefly described. They are suitable for experimental animals, but are not economically practicable for general use. Some control of ticks in nature is exercised by mice, which can completely clear accessible crevices in farm-yard walls of hibernating individuals of *Hyalomma mauritanicum*; wagtails (*Motacilla alba*), which take ticks from the backs of cattle while in flight; and egrets (*Bubulcus ibis*). The protection of the wagtail and recolonisation and possibly domestication of the egret are discussed. The artificial control measures described are washing the cattle with DDT solutions [36 181] and the use of arsenical dips.

ARTHUR (D. R.). **Some Aspects of the Ecology of the Tick, *Ixodes ricinus*, L., in Wales.**—*Bull. ent. Res.* 39 pt. 3 pp. 321-337, 9 figs., 11 refs. London, 1948.

An account is given of a comprehensive ecological study of the distribution of *Ixodes ricinus*, L., in Glamorgan, together with general data on its distribution in Wales. In Wales, particularly in the south, it infests cattle more heavily

than sheep, and occurs in considerable numbers on horses and dogs and in Merioneth on goats. Examination of several thousands of ticks failed to reveal any other species on sheep, cattle or horses in Wales. The data in this paper are based on the occurrence of adult females on domestic stock and of all stages recovered from grassland by the blanket method [R.A.E., B 32 105].

Surface geology in Glamorgan is very complex. The relief features are considered in four main divisions (the coalfield upland, the border ridges of the coalfield, the coastal regions and the Gower peninsula), and the geology and vegetation and the distribution of *I. ricinus* in them are discussed. Roughly 200 of the 813 sq. miles of Glamorgan are infested, populations being heaviest and most generally spread on land that lies below 400 ft., but even within such limits, distribution is markedly discontinuous, the presence of the ticks coinciding largely with bad drainage [cf. 32 232]. The extent of continuous distribution is greatest along the southern flank of the coal measures and in the Gower Peninsular.

For the general survey, Wales was divided into the northern, central and southern zones, each of which is defined and described. Distribution of the tick is influenced by superficial soil deposits. Infestation in the north is limited to an area in which a covering of boulder clay impedes drainage; in the centre, it is sporadic in spite of the existence of much ill-drained land, as large areas are not grazed by stock; and in the south, it is much more prevalent at altitudes below 600 ft. Two peaks of activity in the year are usual, but activity with one peak, beginning towards the end of May, remaining low until July, then rising rapidly in August, thereafter declining in September and October, occurred sporadically in the north and more frequently in the central region. It appeared to be absent from the south. In South Wales, nymphs favour rush rather than bracken, while only 2.6 per cent. of tick-infested land is rough grass and heather. In the central region, bracken is infested 3.4 times more often than rush, while in the north the corresponding figure is 1.4, with rough grass and heather occupying some 13.5 per cent. of tick-infested land.

The pH values of the soil from some 187 infested fields in Wales lay between 4.4 and 5.2, and it appears that pH has an influence on infestation in that acidity encourages matting of the herbage, and tick survival is correlated with the establishment of mat [cf. 27 93; 32 232]. Lime applied to the soil in the form of ground burnt limestone containing 96 per cent. calcium oxide at three tons per acre reduced the degree of acidity and destroyed mat. Its effect on the tick population was comparable with that of benzene hexachloride and DDT applied at the same time, but would presumably be more lasting. An investigation of four adjoining tracts of vegetationally different land (rush, bracken, heather, winberry and ley) showed greater populations and a greater rate of activity in rush land. There was indication that infestation was influenced by topographical situation even on land with the same type of vegetation and depth of mat. Readjusting environment from rough to ley conditions brought about a significant reduction in tick population. A salt marsh adjoining an infested non-salt marsh was found to be free of ticks, probably because of inadequate mat formation and relatively good drainage by tidal channels.

Within an area where the usual two peaks per year occur, irregularities in the periodicity of infestation on cattle were observed on some farms. This appeared to be related to the nature of the sward, and was noticed particularly where isolated patches of damp ground occurred in good pasture. These patches may harbour ticks while the rest of the pasture is free, and when cattle move to them, as they tend to do to obtain protection from warble flies (*Hypoderma lineatum*, Vill., and *H. bovis*, Deg.) in bright warm weather, they become infested with ticks. It is recommended that such patches should be fenced off and shade provided and also water in which the cattle can stand.

DAKSHINAMURTY (S.). **The common House-fly, *Musca domestica*, L., and its Behaviour to Temperature and Humidity.**—*Bull. ent. Res.* **39** pt. 3 pp. 339–357, 1 pl., 6 figs., 38 refs. London, 1948.

A detailed account is given of laboratory experiments in which house-flies (*Musca domestica*, L.) of known ages were exposed to various humidity gradients at constant temperature and temperature gradients at constant humidity at a light intensity of 30 foot candles. The constants were chosen so as to keep the flies in movement without flight. The technique and apparatus are described, including the method of obtaining constant humidity in a temperature gradient, and the results are analysed statistically.

When the flies were placed at 25°C. [77°F.] in gradients of 20–40, 40–60, 60–80 and 80–100 per cent. relative humidity, the lower humidity was chosen in each case by flies of both sexes previously conditioned for half an hour at 90 or 30 per cent. relative humidity and the choice was significant except for females conditioned at the lower humidity and exposed to 60–80 per cent.

At constant humidity, expressed by either the relative-humidity or the saturation-deficiency scale, the flies moved towards 30°C. [86°F.] whether they were in gradients of 20–30°C. [68–86°F.] or 30–40°C. [86–104°F.]. Flies exposed in gradients of 27–33°C. [80.6–91.4°F.], in which dry air was associated with 27°C. in the relative-humidity scale and with 33°C. in the saturation-deficiency scale, preferred the temperature associated with dry air in each case.

A study of the activity of *M. domestica* at four different combinations of temperature and humidity showed that activity was greatest when temperature was high and humidity low, least when temperature and humidity were both high and intermediate at low temperatures irrespective of humidity.

These results are compared with those of similar investigations on other insects, physiological grounds for them are discussed, and general experience with regard to the behaviour of house-flies in nature is explained in the light of them.

HAFEZ (M.). **A simple Method for Breeding the House-fly, *Musca domestica*, L., in the Laboratory.**—*Bull. ent. Res.* **39** pt. 3 pp. 385–386, 12 refs. London, 1948.

Various kinds of dung, not always easy to obtain under laboratory conditions, and various mixed media, relatively laborious to prepare, have been used by different workers for rearing *Musca domestica*, L., for experimental purposes. To provide about 100 larvae daily at Cambridge, the author found that the simplest and most satisfactory medium was a mixture of three parts milk to one part water by volume on pads of cotton wool. One of these pads was placed in a petri dish in the breeding cage. The adults fed on the milk and the females laid their eggs on the pad, which was changed every 24 hours. The egg-bearing pads were transferred to large jam jars having finely perforated tin lids and each containing a fresh pad to provide food for the hatching larvae. The jars were kept at 27°C. [80.6°F.]. Fully grown healthy larvae were obtained in 4–5 days, and the larval and pupal stages and the developmental period from egg to adult lasted 5–6, 4–5 and 10–12 days, as compared with 6–8, 4–6 and 11–15 days, respectively, when Richardson's medium [*R.A.E.*, B **20** 261] was used. Results were best when the pad was only moderately soaked and the accumulation of too many eggs on one pad was avoided.

PARKER (A. H.). **Stimuli involved in the Attraction of *Aedes aegypti*, L., to Man.**—*Bull. ent. Res.* **39** pt. 3 pp. 387–397, 1 fig., 9 refs. London, 1948.

Laboratory investigations on the reactions of females of *Aedes aegypti*, L., to certain stimuli normally associated with the surface of the human body are

described, with details of the technique employed, the results are discussed and the need for caution in assuming them to apply where conditions differ from those under which they were obtained is emphasised. The apparatus used was such that the mosquitos could not touch the source of stimulation, being separated from it by a piece of scrim (netting) and a space about 1 cm. wide. Attraction was indicated by the congregation of females on the scrim. The experiments were carried out at 28°C. [82.4°F.] and a relative humidity of 50-70 per cent., and the females used had fed on sugar solution only.

The following is substantially the author's summary. The palm of the hand, collected sweat at room temperature, moisture at room temperature and moisture at body-surface temperature all proved attractive. A warm surface at or slightly above body-surface temperature was neither attractive nor repellent. The four types of stimulus found to be attractive also had marked activating effects, which were much greater for the hand and warm moisture than for cold sweat and cold moisture. Due allowance for the complication introduced by these differences in activation having been made, cold sweat appeared to be slightly, but significantly, more attractive than cold moisture. A reaction to olfactory stimuli is presumed to have been responsible for this. Such stimuli, however, are not considered to have been of much importance in comparison with warmth and moisture; moisture at body-surface temperature had very nearly the same, or possibly the same, attractive effect as the intact hand.

WILSON (S. G.). **The Feeding of "Gammexane" and DDT to Bovines.**—*Bull. ent. Res.* **39** pt. 3 pp. 423-434, 3 figs., 2 refs. London, 1948.

The effect on cattle and on certain blood-sucking Arthropods feeding on them of administering BHC (benzene hexachloride) orally were studied in Uganda; the BHC used contained 13 per cent.  $\gamma$  isomer. The first series of experiments showed that 0.5 gm. BHC per kg. body weight given as a drench on two successive days was lethal to a calf, but 0.25 gm. per kg. on two successive days followed by 0.125 gm. on the third and fourth days was well tolerated and the BHC remained in the blood for 41 days in sufficient concentration to kill feeding individuals of *Glossina palpalis*, R.-D., within 24 hours. Throughout the same period, the calf was exposed in a place in which ticks infected with *Theileria parva* (East Coast fever) were present. No adults of four species remained attached long enough to become fully engorged and the calf did not become infected. After a single dose of 0.25 gm. per kg., the BHC remained in the blood of four other calves in concentrations sufficient to kill engorged ticks and *G. palpalis* for only 10-12 days and failed to protect an animal from East Coast fever when it was allowed to graze on pasture heavily infested by infected nymphs of *Rhipicephalus appendiculatus*, Neum.

Five calves susceptible to East Coast fever were given BHC at dosages of 0.25 gm. or less per kg. and exposed for a month to attack by five common species of ticks on a pasture in an area where East Coast fever was known to occur. Those given doses of 0.25 or 0.125 gm. per kg. weekly or 0.125 gm. twice weekly were protected from East Coast fever, but those given 0.1 gm. weekly or 0.25 gm. fortnightly were not. At all these dosages, the concentration of BHC in the blood was sufficient to kill feeding examples of *G. palpalis* during the period the calves were under treatment and for periods of 10-29 days after the final dose. BHC given to calves suffering from East Coast fever and trypanosomiasis (*Trypanosoma congolense*) had no effect on the course of these diseases. In further tests, doses of 0.3 gm. BHC per kg. were toxic to calves, but older animals were more tolerant. Hypersensitivity, muscular tremors and general paralysis were the main signs of toxicity, and gross pathological changes were most obvious in the liver and urinary system.

Two bovines given DDT powder containing 83 per cent. p,p' isomer as a drench at 0.25 and 0.5 gm. per kg., respectively, showed no apparent ill effects, but their blood was not sufficiently toxic 18 hours later to stop many males and females of *G. palpalis* from engorging or to prevent some from surviving. No further experimental work was done with DDT as the results with BHC were so much more promising.

JACKSON (C. H. N.). **Some further isolated Generations of Tsetse Flies.**—*Bull. ent. Res.* **39** pt. 3 pp. 441–451, 8 refs. London, 1948.

In August 1946, four more liberations of tsetse flies in the habitats of related species were made in Tanganyika by exposing pupae at the chosen sites for three days [cf. *R.A.E.*, B **34** 199]. About 30,000 pupae of *Glossina morsitans*, Westw., were exposed at the same site as in the previous year in the habitat of *G. swynnertoni*, Aust., and *G. pallidipes*, Aust., and about 27,500 pupae of *G. swynnertoni* in a habitat of *G. morsitans* in eastern Kahama District. About 20,000 pupae of each species were exposed together in a habitat of *G. pallidipes* at Shinyanga in an isolated block of bush from which *G. swynnertoni* had almost or quite disappeared. The number of flies that emerged was estimated as 4,000 for each of the first two releases and 3,000 for each of the second two. The mean daily weights of water, fat and residue of males recaptured on each week-day from the day following release to the 66th day are shown in a table, and the means for all males recaptured are compared with the means for control indigenous males caught at the same time and with the means for freshly emerged males less than 24 hours old. The findings are discussed.

The following is largely based on the author's summary of the results. Recaptures of *G. morsitans* from the habitat of *G. swynnertoni* and *G. pallidipes* in 1946 were little more than a third of the total in 1945 when the release was made nearly a month earlier [and nearly as many flies emerged], but the number of teneral flies recaptured was about the same. The males were in poorer condition than in the previous year but were nearly as heavy, in later life, as wild ones of the same species in their native habitat, which is contrary to previous experience [34 198]. In relation to initial weight, non-teneral males of *G. swynnertoni*, whether in their own home or as aliens in the habitats of other species, were heavier than those of *G. morsitans*, and the alien individuals were heavier in fat and water than the native ones. This is contrary to the author's experience with *G. morsitans* in 1943–44 [34 198] and cannot be explained. A possible explanation of the differences between the two species may be that *G. swynnertoni*, after taking its first meal, dies if it falls much below its initial weight at emergence, whereas the larger *G. morsitans* and particularly *G. pallidipes* do not.

Observations on the activity of the sexes in *G. morsitans* and *G. swynnertoni* and on the relation between wing-fray and age [34 199] were confirmed, except that *G. swynnertoni* in the habitat of *G. morsitans* showed an extremely slow rate of fray. Scanty observations on *G. morsitans* suggested that the rate of wing-fray during the rainy season is not very different from that during the dry. Teneral flies below the average size were shown to be comparatively non-viable; and it is concluded that about 10 per cent. are too small to survive long enough to obtain a meal. There is no suggestion that smaller non-tenerals are less viable.

The external characters that distinguish the larvae of the first and second instars are described. Although copulation between *G. morsitans* and *G. swynnertoni* is random, insemination from interspecific matings often fails, and the sterile egg is aborted. In such cases, the left ovary ovulates before the normal time. The finding that the flies and pupae live at about the temperature

of the standard climate as recorded in a Stevenson screen [34 199] was substantially confirmed, but it is possible that the adults live at a slightly lower temperature and the pupae at a slightly higher one.

HOCKING (K. S.) & MACINNES (D. G.). **Notes on the Bionomics of *Anopheles gambiae* and *A. funestus* in East Africa.**—*Bull. ent. Res.* 39 pt. 3 pp. 453–465, 5 figs., 10 refs. London, 1948.

Observations on certain aspects of the bionomics of *Anopheles gambiae*, Giles, and *A. funestus*, Giles, were made in Kenya in 1945–46 with a view to facilitating the efficient application of control measures. Females of both species entered huts and tents throughout the night, but more of *A. gambiae* entered between 1 and 4 a.m. and more of *A. funestus* just before dawn than at other times [cf. *R.A.E.*, B 30 182]. Males entered only just before dawn. The rate of development of the ovaries was studied in individual females of both species collected in nature and isolated in cages in the laboratory. The correlation between the five stages of follicle development [cf. 29 93] and external morphology was first determined, and five external characters corresponding to them were adopted for subsequent observations. These comprise: no visible ovaries or blood; abdomen distended and ovaries occupying not more than three abdominal segments dorsally and two ventrally; ovaries occupying not more than six segments dorsally and four ventrally; no visible red blood and ovaries occupying seven or all eight of the segments dorsally and three or four ventrally; and stomach not visible or visible only as a narrow black line. The mean period between egg-layings at a mean temperature of 25.5°C. [77.9°F.] was about 4.75 days in both species.

Catches made between May and November 1945 indicated that females of *A. gambiae* and *A. funestus* did not normally spend more than 24 hours in any one hut, but moved between huts every night whether in need of a blood-meal or not, and further observations during the early rains (November to January) that they did not rest in the open bush in the daytime except when newly emerged and just before and just after egg-laying.

It was observed that females of both species would sometimes feed daily whereas digestion of a full blood-meal occupied 24–72 hours in *A. gambiae* and 24–96 hours in *A. funestus*. In only one case (*A. gambiae*) in studies of 40–50 females of both species was the cycle of ovarian development completed after a single blood-meal immediately following the deposition of the previous batch of eggs. However, one meal apparently suffices in nature. The numbers of eggs in a batch averaged 175 for *A. gambiae* and 123 for *A. funestus* in the dry season, but less in the wet season. Isolated females of both species laid several batches of fertile eggs, so that they probably pair only once. The act of oviposition in the two species and hatching are described.

GOLDING (F. D.). **The Insect Pests of Nigerian Crops and Stock.**—*Spec. Bull. agric. Dep. Nigeria* no. 4, [1+]<sup>1</sup>48 pp. Lagos, 1946.

This bulletin includes lists of the blood-sucking Diptera, chiefly Tabanids and *Glossina* spp., known or likely to attack livestock in Nigeria.

JAYEWICKREME (S. H.). **A Note on the Breeding of Nymphs of the Trombiculinae (Acarina).**—*Ceylon J. Sci.* (B) 23 pt. 2 pp. 95–96, 3 refs. Colombo, 1946.

A description is given of a method used in Ceylon to rear nymphs of Trombiculid mites from larvae taken on rodents [cf. *R.A.E.*, B 36 209]. The rodents are killed by coal gas, and the larvae picked off with a fine scalpel. In the case of embedded larvae, it is sometimes necessary to cut away the

epidermal tissues with the mites attached. The mites are transferred to an excavated glass block containing a small piece of cellulose wadding of coarse texture, which is preferable to cotton-wool, though any absorbent material, such as rag or blotting paper, may be used. The wadding is moistened with a few drops of water to immobilise the active mites, which are capable of very rapid movement, and the excess of water does not appear harmful. If more than 10-15 larvae are placed in a glass block, daily observation is rendered difficult. A glass cover is placed over each block and held in position by vaseline. Humidity is the crucial factor in keeping the larvae alive; most species are very susceptible to low humidity, so that conditions of saturation are advisable. Larvae that become caught up in the minute droplets of water that condense on the cover or the block are picked up daily and transferred to the wadding. After a period that varies with the species and probably with the degree of engorgement, the larvae enter a quiescent phase, and the nymphophane is formed within the larval skin. When the nymph emerges, the larval pelt can be picked up and mounted, and in this way larvae and nymphs can be correlated. Very few larvae were killed by fungi, and the risk of this can be minimised by transferring the larvae to a fresh block as soon as they have detached themselves from the epidermal tissues.

MICHENER (C. D.). **Observations on the Habits and Life History of a Chigger Mite, *Eutrombicula batatas* (Acarina : Trombiculinae).**—*Ann. ent. Soc. Amer.* **39** no. 1 pp. 101-118, 34 figs., 12 refs. Columbus, Ohio, 1946.

An account is given of the life-history, morphology of all stages and distribution of *Eutrombicula batatas*, L., a mite commonly found in Panama, of which *Trombicula hominis*, Ewing [*R.A.E.*, B **21** 277] and *Acariscus* (*T.*) *flui*, van Thiel [*cf.* **29** 197; **31** 171] are considered synonyms. The genus *Acariscus* [**31** 171] is not considered distinct from *Eutrombicula*, as the number of the abdominal setae, by which they were distinguished, was found to be an intergrading character.

In Panama, *E. batatas* occurred in abundance only in grassy areas round houses and in villages where domestic animals and fowls were numerous. Larvae were collected from man, goat, dog, rat, fowls, particularly young ones, which appeared to be the most important hosts, and wild birds of three species. *E. batatas* was abundant in favourable localities throughout the rainy season but gradually disappeared with the onset of dry weather. It is not known how it survives the dry season; it may enter cracks in the soil, but attempts to find the mites by digging were unsuccessful.

The egg, larval, nymphal and adult stages lasted 4-5, up to 28, 16-45 and up to 45 days, respectively, in the laboratory and are separated by intervening stages termed deutovum, protonymph [nymphophane] and preadult, which lasted 6-7, 5-7 and 5-7 days. The deutovum is the stage revealed when the egg shell splits and from which the larva emerges, and the protonymph and preadult are formed within the integument of the full-fed larva and nymph, respectively, so that the nymph and adult emerge through two integuments. The eggs were laid singly on the surface of moist soil. Larvae survived in the laboratory for nearly two weeks without feeding, and remained attached to fowls for 2-10 days, the majority feeding for 3-4 days. The food of nymphs and adults is not known; nymphs developed normally in the absence of living animals, portions of living green plants, insect excreta and freshly dead animals and plants, and fungi also appeared unnecessary. Since both stages have sucking mouth-parts, it is thought probable that they feed on soil moisture rich in organic matter [*but cf.* **36** 209].

The rearing methods employed are briefly described. Fully engorged larvae were obtained by placing hosts in wire-mesh cages above a shallow tray of

water and removing the larvae that fell on to the water with small squares of absorbent paper. When these had dried, so that the larvae could move about, they were placed in glass jars lined with a thin layer of plaster of paris to absorb any moisture due to condensation. After transformation, the nymphs were shaken into rearing jars in which the glass bottom had been replaced by plaster of paris. Soil and other ingredients to simulate the natural environment were then placed in the jars, the best results being obtained with a mixture of sterilised soil and chicken manure [see next abstract]. The jars were left open and water added daily or oftener, so that a gradient of humidity was produced in the soil, in which the mites could choose the most favourable level. Transformation to the adult stage took place readily, and also oviposition, particularly if the temperature was raised for a few days. The jars were covered when larvae were expected to appear. The latter were removed on wet paper to shell vials, which were fastened to the skin of host animals so that the larvae could attach themselves as the paper dried. A small plaster cell with a cover made of a microscope slide held in place with a rubber band was found convenient for making special observations. Water could be added from the outside through the plaster without disturbing the contents. Nymphs and adults, however, did not survive for more than a week or two in constant contact with the plaster.

MELVIN (R.). **A Note on the Culturing of Chiggers (Trombiculidae).**—*Ann. ent. Soc. Amer.* **39** no. 1 pp. 143–144. Columbus, Ohio, 1946.

A short account is given of a method by which *Eutrombicula batatas*, L. (*hominis*, Ewing) and an undescribed species of the same genus were reared in Panama for use in laboratory observations. The procedure was substantially the same as that described in the preceding abstract, and the medium used consisted of one part chicken manure and five parts soil. Glass rearing jars were about half filled with this and placed on blotting paper impregnated with dimethyl phthalate to prevent the escape of the mites. Adults used for starting cultures were placed singly in separate bottles and left for 8–14 days. If living larvae were required, the bottles were plugged with cotton-wool surrounded with silk cloth, but for taxonomic studies the larvae were allowed to escape and be killed by the dimethyl phthalate. Newly hatched larvae for rearing were removed by means of a camel's hair brush to the bare axillary skin of chicks 1–3 weeks old, to which a large percentage attached themselves. The chicks were kept in glass battery jars for 5–6 days, after which time the larvae had engorged and detached and were transferred to culture bottles. Nymphs appeared 9–18 days later. Apart from weekly applications of water, the jars received no attention until about two weeks after the adults appeared. Daily maximum and minimum laboratory temperatures ranged between 30 and 20°C. [86 and 68°F.], but to obtain good egg-production it was necessary to heat the cultures to about 35°C. [95°F.] for 2–3 days; long exposure to that temperature was frequently fatal. The second generation of larvae appeared in about 19 days, and the cycle was repeated with mass cultures.

The two Trombiculids used were reared through two or more generations by this method, and their life-cycles both lasted about three months. The eggs were deposited in clusters [*cf.* preceding abstract], as were those of several other species of which partial life-cycles were completed.

YEAGER (J. F.) & MUNSON (S. C.). **Analysis of Concentration-Survival Time Curves of arsenite-injected Roaches having different Resistances.**—*Ann. ent. Soc. Amer.* **39** no. 1 pp. 145–151, 2 graphs, 1 ref. Columbus, Ohio, 1946.

The following is substantially the authors' summary. Further analysis of data obtained in experiments with *Periplaneta americana*, L., previously

recorded [*R.A.E.*, B 33 25 ; 37 52] has led to certain indications of the reason why some cockroaches injected with a given dose of sodium metarsenite survived for short times, whereas others injected with an equal dose survived longer. An interpretation of the results of this analysis indicates that such differences in survival times are associated with, and may be in part caused by, firstly, differences in the electrolytic dissociation of the poison in the blood of the insects, which may involve differences in the degree of dissociation at high concentrations, the rate of change of degree of dissociation with change of concentration, and the concentration at which complete dissociation is attained ; and, secondly, differences in the capacity of the insect to render ineffective some of the poison that it received, differences in quantity of vital tissues, or differences in both. It is suggested that among the physiological factors that may be involved in the first group are blood volume and chemical composition of the plasma, and in the second group, processes of detoxification and excretion.

These results are also in accord with the idea that the mixing of the poison with the blood and its distribution by it occur more slowly in those insects that have longer survival times. The inflection appears to be more marked in the short than in the long survival-time curves.

GERSDORFF (W. A.). **DDT against House Flies. The comparative Toxicity to Houseflies of p,p'DDT, o,p'DDT, and Pyrethrum Extract.**—*Soap & sanit. Chem.* 22 no. 3 pp. 126–127, 1 fig., 2 refs. New York, N.Y., 1946.

An account is given of tests to compare the toxicity to adults of *Musca domestica*, L., of o,p'DDT with that of p,p'DDT and of pyrethrum extract. Pure samples of the two isomers were used, with melting points of 74.3–74.7° and 107–108°C., respectively. The pyrethrum sprays were prepared from a kerosene extract in which 54 per cent. of the total pyrethrins was pyrethrin I and cinerin I [*cf. R.A.E.*, B 37 66], and refined kerosene was the solvent in all cases. Sprays consisting of 0.25–1.5 mg. per ml. p,p'DDT, 10–60 mg. per ml. o,p'DDT and 0.59–2.36 mg. per ml. pyrethrins were applied by the turntable method [26 246] to groups of about 150 flies, and counts were taken of knock-down after 25 minutes and of mortality after one day. The results are shown in a table, and the mean mortalities are plotted on a graph. From the estimated concentrations giving 50 per cent. mortality, p,p'DDT was 53 times as toxic as o,p'DDT, and this ratio was fairly stable throughout the mortality range, being 44 at 10 per cent. and 60 at the 90 per cent. level. The two isomers were 2.82 [*cf. 35 38*] and 0.0529 times as toxic as the pyrethrum extract at the 50 per cent. level, respectively, but the variation with mortality level was relatively greater, the ratios ranging from 1.7 to 4.4 for p,p'DDT and from 0.038 to 0.073 for o,p'DDT. The knockdown percentages for the two isomers were 1–25 and 2–18, respectively, as compared with 100 for pyrethrum extract at all concentrations.

BARTHEL (W. F.), GERSDORFF (W. A.), LAFORGE (F. B.) & GRAHAM (J. J. T.). **Evaluating Pyrethrum Extract. A Comparison of chemical and biological Methods of evaluating concentrated Extracts.**—*Soap & sanit. Chem.* 22 no. 3 pp. 129, 131, 9 refs. New York, N.Y., 1946.

The following is taken partly from the authors' summary. Comparison of chemical analyses of a sample of purified pyrethrum extract prepared by the nitromethane-charcoal process [*R.A.E.*, B 33 98] showed that the Seil method of analysis gave consistently lower contents of pyrethrins than either the A.O.A.C. or the hydrogenation method. Biological comparisons against houseflies (*Musca domestica*, L.) of sprays prepared from four purified preparations with a standard spray, all at concentrations based on the A.O.A.C. evaluation,

showed that all four underwent purification without loss of insecticidal activity, and one of them retained its full activity for ten months when kept at a temperature of 2°C. [35-6°F.], whereas a commercially prepared pyrethrum concentrate (20 per cent. for aerosols) showed a continuous loss of toxicity to flies when stored at room temperature and a 27 per cent. loss of pyrethrins at the end of eight months. According to analysis by the A.O.A.C. method, the percentage of pyrethrin I to total pyrethrins was 53 in the purified material and 55 in a standard pyrethrum extract. Since pyrethrin I causes higher mortality of house-flies than pyrethrin II, the standard extract should be slightly the more toxic at comparable concentrations.

SCHROEDER (H. O.), MADDEN (A. H.), LINDQUIST (A. W.) & JONES (H. A.).  
**Concentrated Sprays tested for Utility in Control of Flies and Mosquitoes.**—  
*Soap & sanit. Chem.* **22** no. 4 pp. 145, 147, 153, 2 refs. New York, N.Y., 1946.

In view of the good results obtained in previous tests with highly concentrated and finely atomised DDT sprays against flies and mosquitos in large rooms [cf. *R.A.E.*, B **34** 168] and the successful use of DDT aerosols against mosquitos in factory buildings in the north-eastern United States, a comparison was made of the two methods in a gymnasium with a floor space of about 12,225 sq. ft. and an arched ceiling 35-40 ft. high, giving a total capacity of 340,000 cu. ft. Test insects were exposed in 16 cylindrical, 16-mesh screen-wire cages, 7½ ins. long and 2¾ ins. in diameter, each containing about 35 adults of *Musca domestica*, L., and 50 of *Anopheles quadrimaculatus*, Say. Two cages, one swinging and one stationary, were placed in each of eight positions about the hall at heights of 8-35 ft. The exposure period was ten minutes in the swinging cages and one hour in the others. All doors remained closed during treatment and exposure, but a row of small windows near the ceiling at one side could not be closed. The sprays were applied with a paint-gun sprayer. In the first two tests, they were discharged while the operator walked up and down a 50-foot path in the middle of the floor, and comprised 285 ml. of a mixture of 10 per cent. DDT and 20 per cent. orthodichlorbenzene in kerosene and 310 ml. of 10 per cent. DDT, 10 per cent. orthodichlorbenzene and 45 per cent. methyl chloride in kerosene, respectively. In the third test, 310 ml. of the first spray was discharged in the centre of the hall above an electric fan adjusted to drive the spray towards the ceiling. In the fourth, 280 gm. of an aerosol containing 10 per cent. DDT, 10 per cent. cyclohexanone, 5 per cent. motor oil (S.A.E. No. 30) and 75 per cent. methyl chloride was discharged from a 1 lb. container carried up and down as in the first two tests. The average diameter of air-float particles in these tests was 5-18 microns.

The results showed that the least effective spray treatment was quite as effective as the aerosol. The best control was obtained in the third test, in which all the mosquitos were killed and all the house-flies save those in one swinging cage and in two stationary ones, the mortalities in these being 88, 84 and 95 per cent., respectively. The better of the results in the other spray tests was complete kill in all but six cages. The aerosol gave complete mortality of mosquitos in all but one cage but killed all the flies in only three cages. The flies proved somewhat more resistant than the mosquitos in all the tests, and kills were higher in swinging than in stationary cages, indicating that some protection was afforded by the wire-screen. The survival of some insects in certain cages is attributed to incomplete dispersion of the insecticide to all parts of the hall. It is concluded that concentrated sprays show promise for controlling mosquitos annoying workers in factories. Unlike dilute sprays, they do not cause an objectionable fog. A dosage of 1 ml. per 1,000 cu. ft. of 10 per cent. DDT is adequate, but concentrations of up to 20 per cent. can be used; the addition of 3 per cent. pyrethrins decreases the knockdown time.

Other auxiliary solvents, such as cyclohexanone and tetrahydronaphthalene, can be substituted for orthodichlorobenzene, which may not be quite safe for use in small confined spaces.

SCHWITZGEBEL (R. B.). **Roach Powder. DDT Formula improved by the Addition of "Lethane A-70" to improve Knockdown. A Discussion of combination Roach Powders.**—*Soap & sanit. Chem.* **22** no. 5 pp. 131–133, 1 fig. New York, N.Y., 1946.

Since DDT powders are slow in action against cockroaches, tests were carried out on the effect of the addition to them of Lethane A-70 (90 per cent.  $\beta,\beta'$ -dithiocyanodiethyl ether), which has a rapid knockdown action [*cf. R.A.E.*, **B** **33** 97; **34** 47]. The DDT powder used contained 50 per cent. technical DDT in pyrophyllite, and 90 per cent. of the particles were less than five microns in mean diameter. The diluent was a diatomaceous earth (Dicalite IG<sub>2</sub>). The tests were made by the tower and tray methods [*cf. 33* 97] against adult male cockroaches. In tests by the tower method, a combination of 5 per cent. Lethane A-70 and 5 per cent. DDT killed 83 per cent. of *Blattella germanica*, L., in 48 hours, as compared with 66 and 64 per cent. killed by 10 per cent. Lethane A-70 and 10 per cent. DDT, used separately, and (with a lower rate of application) the addition of 2.5, 5 and 7.5 per cent. Lethane A-70 to 10 per cent. DDT increased the mortality from 20 per cent. in 48 hours to 74, 82 and 79 per cent., respectively. In further comparisons made by the tray method, counts of dead and moribund cockroaches were made after exposure for periods ranging up to 24 hours. A 50 per cent. kill of *B. germanica* was given within four hours by 10 per cent. Lethane A-70, within 24 but not eight hours by 10 per cent. DDT and within eight hours by a dust containing 5 per cent. of each. When varying amounts of Lethane A-70 were added to 10 per cent. DDT, the speed of kill of adult males of both *B. germanica* and *Periplaneta americana*, L., varied directly with the proportion of Lethane. The amount of powder used in the tests on *Blattella* did not exceed 250 mg. per 100 examples, but in a final test the dose was increased to 500 mg., in order to approximate to conditions of actual use. At this rate, a powder containing 10 per cent. DDT and 5 per cent. Lethane A-70 gave 94 per cent. mortality in an hour, during which period 10 per cent. DDT alone had no visible effect.

LINDQUIST (A. W.), TRAVIS (B. V.), MADDEN (A. H.) & JONES (H. A.). **Aerosol Formulation. Laboratory Tests with Pyrethrum and DDT Aerosols against the Common Malaria Mosquito and the Housefly.**—*Soap & sanit. Chem.* **22** no. 5 pp. 135, 137, 139, 141, 143, 1 fig., 2 refs. New York, N.Y., 1946.

A detailed account is given of experiments already noticed [*R.A.E.*, **B** **34** 132] on the use of aerosols containing DDT and pyrethrum extract against *Anopheles quadrimaculatus*, Say, and *Musca domestica*, L. The basic DDT aerosol used contained 5 per cent. DDT and 10 per cent. cyclohexanone in dichlorodifluoromethane and it was released at the rate of about 150 mg. DDT per 1,000 cu. ft. The rate for the aerosol of pyrethrum extract and sesame oil was 12 mg. pyrethrins per 1,000 cu. ft. The combined aerosol was produced by adding 0.2 per cent. pyrethrins to the basic DDT solution.

Male mosquitos were found to be less resistant than females to the aerosols, although in some cases the difference in mortality was slight. The relative resistance of male and female house-flies was not tested. Tests were also made against both insects with aerosols containing a thiocyanacetate (Thanite **36** 165) and a thiocyanate preparation (Lethane 384 Special [**33** 22, etc.]). Neither was very effective.

ANNAND (P. N.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, 19[44-]45.—63 pp.** Washington, D.C., U.S. Dep. Agric., 1946. **Report . . . 19[45-]46.—63 pp.,** 1 map, 1 fig. 1947.

It is stated in the first of these reports that woodland plots in Georgia were freed from infestation by the lone star tick [*Amblyomma americanum*, L.] and the black-legged tick [*Ixodes scapularis*, Say] throughout the greater part of their season of activity by treatment with DDT at 1 lb. per acre [cf. *R.A.E.*, B 35 24]. The best results were obtained when emulsified solutions containing 1 lb. DDT per 50 U.S. gals. water were sprayed on to the ground, weeds and low-growing bushes. Fairly good control was also obtained with a 10 per cent. dust. Similar treatments were not satisfactory against the American dog tick [*Dermacentor variabilis*, Say], although some promising results were obtained [cf. also 35 129]. The common chigger [*Eutrombicula alfreddugèsi*, Oudm.] was not controlled by even as much as 6 lb. DDT per acre. During the second year, good control of *A. americanum* was given on Bull's Island, South Carolina, by dusts or sprays of DDT applied from aircraft.

Solutions of DDT in oil are stated in the first report to be unsafe for use on domestic animals because some of the toxicant may be absorbed by the animal. Emulsified solutions and suspensions of DDT in water applied at the rate of 2 gm. DDT per animal gave excellent control of horn flies [*Siphona irritans*, L.] on cattle for 2-3 weeks [cf. 35 91, 92, 93, 189]. Emulsion sprays or dips containing 0.2 per cent. DDT [cf. 34 97] were about equally effective, but emulsions containing 0.1-0.15 per cent. DDT were less so. In the second year, a water suspension containing 1.5 per cent. DDT at the rate of about 1.5 U.S. pints per animal was effective for at least 3 weeks. Horses infested by the winter tick [*Dermacentor albipictus*, Pack.] were treated experimentally in the first year with emulsions containing DDT. One containing 0.8 per cent. DDT and prepared by dissolving 20 per cent. (by weight) of DDT in soluble pine oil and diluting this solution with water at the rate of 6 oz. per U.S. gal. was applied with a sponge to saturate the hair of the animals. Two thorough applications during the tick season prevented attachment and killed ticks that had already become attached. The pine oil did not injure the animals. An emulsion containing 0.4 per cent. DDT did not give such enduring protection. In tests to ascertain the minimum concentration of DDT in dips for the control of lice on cattle, 0.08 per cent. killed all the motile forms of the short-nosed louse [*Haematopinus eurysternus*, Nitzsch] and the red louse [*Damalinia bovis*, L.] but 0.15 per cent. was required to control all the motile forms of the long-nosed louse [*Linognathus vituli*, L.] and the capillate louse [*Solenopotes capillatus*, End.]. There was no evidence that eggs were killed, but the residue left in the hair killed the young lice that hatched during the four or five days following dipping. A second treatment 16 days after the first eliminated the infestation. *H. eurysternus* was found in Florida for the first time in the autumn of 1945.

In the second year, excellent control of the Gulf coast tick [*Amblyomma maculatum*, Koch] was obtained by applying smears containing 5 per cent. DDT, 47 per cent. resin, 33 per cent. Herculyn (hydrogenated methyl abietate) and 15 per cent. dibutyl phthalate to the ears of infested cattle, and reinfestation was prevented for 3-6 weeks. DDT suspensions were found to be more desirable than solutions and emulsions in spraying dairy barns for the control of house-flies [*Musca domestica*, L.]. The most effective treatment developed is 1 U.S. gal. of a spray containing 2.3 per cent. DDT per 300 sq. ft. of surface. Laboratory tests showed that benzene hexachloride is the most toxic insecticide known against adults and larvae of *M. domestica*, being about 8-10 times as toxic as DDT.

It is stated in the first report that investigations on the structure of the pyrethrins have shown that the so-called pyrethrolone, the alcoholic portion

of the pyrethrin esters, is made up of a major component for which the name pyrethrolone is retained and a considerable proportion of a second compound called cinerolone, which contains one less carbon atom in the side chain of the molecule. Pyrethrins I and II and cinerins I and II were prepared from both optically active and racemic pyrethrolone and cinerolone. During the second year, partial synthesis of the pyrethrins and cinerins was carried out and total synthesis of the cinerins partly completed. In tests against *M. domestica*, pyrethrin I, cinerin I and pyrethrin II were about 6, 4 and 1.5 times as toxic, respectively, as cinerin II. The essential oil of *Eugenia haitiensis* was found to be toxic to *M. domestica* and mosquitos and to have a considerable knockdown effect. The active fraction of this oil was identified as cineole.

**Report of the Fifth Commonwealth Entomological Conference 22nd-30th July 1948.**—[1+]ii+112 pp., 3 refs. London, Commonw. Inst. Ent., 1948. Price 7s. 6d.

In addition to an account of the Fifth Commonwealth Entomological Conference, which was held at London in July 1948, with the resolutions passed by it, this report includes three appendices. The first is a memorandum on the work of the Commonwealth Institute of Entomology from 1st April 1935 to 31st March 1948, the second contains reports of the proceedings of committees, including one dealing with the nomenclature of insecticidal chemicals, and the third contains the text of the papers read at the scientific meetings and reports of the discussions that followed them. The subjects for discussion, with (in brackets) the authors of the opening papers [cf. also *R.A.E.*, A 37 114] included Recent Developments in Insecticides, pp. 28-35 (R. A. E. Galley); Mode of Action of new Insecticides, pp. 35-37 (V. B. Wigglesworth); Application of Insecticides from the Air, pp. 54-59 (D. L. Gunn); Estimation of Insect Populations in the Field, pp. 72-76 (A. H. Strickland); and Tsetse [*Glossina*] Research and Control, pp. 83-89 (T. A. M. Nash, K. R. S. Morris).

VAN ZWALUWENBURG (R. H.). **Recent immigrant Insects.**—*Hawaii. Plant. Rec.* 50 no. 1 pp. 11-17, 4 figs., 5 refs. Honolulu, 1946.

The insects recorded from Hawaii in this paper include a beetle, *Rhpidius* sp., of which eight individuals were taken in a light-trap operated on Oahu between 27th June and 20th August 1945. The larvae are parasitic in the cockroach, *Blattella germanica*, L., a parasitised example of which was found in January 1944 in an aeroplane arriving at Honolulu from the south Pacific.

PEMBERTON (C. E.) & ROSA (J. S.). **Life History of a new Parasite of the Black Widow Spider in Hawaii.**—*Hawaii. Plant. Rec.* 50 no. 1 pp. 29-37, 11 figs. Honolulu, 1946.

An account is given of the bionomics of the species of *Eurytoma* that was reared from egg sacs of *Latrodectus mactans*, F., and *L. geometricus*, Koch, in Hawaii in 1945 [cf. *R.A.E.*, B 37 43]. It is widespread on the island of Oahu, where it has apparently been introduced quite recently, and has been distributed to other islands of the group. Its immature stages are briefly described. Observations showed that the eggs are deposited singly or in small groups through the walls of host egg sacs and hatch at summer temperatures indoors in Honolulu, in 45-48 hours. The larvae, which are sluggish, pierce the spider's eggs with their mandibles and absorb the semi-liquid contents. They doubled in size within 48 hours of hatching and completed development in six days, by which time each larva had devoured at least one egg; usually most of the eggs in a sac were emptied. They pupated a day later, and the pupal stage lasted 5-6 days. The males, which represented only 2-4 per cent. of the adults,

emerged a few hours before the females, and pairing took place within the egg sac. After a few hours, the adults left the sac through circular holes bitten in the wall. Usually 3-5 holes served all the parasites present. Oviposition began after 3-4 days and was normally completed within two weeks of emergence. As many as 53 mature eggs were dissected from a week-old female that had no opportunity to oviposit. Adults were kept alive in glass tubes for several weeks without difficulty, the longest life-span of a single female being 38 days.

The number of parasites reared from a single egg sac varied from less than 25 to 286; the average was under 100. When an excessive number of eggs was placed in an egg sac, resulting larvae and adults were undersized. As a rule, all the eggs in a sac were destroyed, irrespective of the number of larvae in it.

WILLIAMS (F. X.). **Entomology.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1944-45* pp. 16-22. Honolulu, 1946.

During the year ended 30th September 1945, the cockroach parasite *Ampulex compressa*, F., was found to be established on Maui as well as on Oahu and Kauai [cf. *R.A.E.*, B **34** 89-90]. A living individual was first observed on Maui in June 1945 at a point ten miles from the site of the first liberations in November 1941 and March 1942. Some 12,338 insects were taken from Army and Navy aircraft landing at Oahu during the year from regions outside the Hawaiian Islands [cf. **34** 90]. Only 88 of these were alive, but about 20 of them represented species not present in Hawaii. They included one adult of *Aedes dorsalis*, Mg., one of *A. sollicitans*, Wlk., and one of *Culicoides* sp. Among the dead insects that belonged to species not known in Hawaii, there were five adults of *Anopheles*, including one female of *A. punctulatus*, Dön., filled with blood, 58 mosquitos of other genera and a few other Diptera.

POST (R. L.), MUNRO (J. A.) & SOMSEN (H. W.). **Control of Mosquitoes in recreational Areas.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **10** no. 2 pp. 61-66, 8 refs. Fargo, N. Dak., 1947.

Experiments were carried out in North Dakota in 1947 to ascertain whether satisfactory local control of mosquitos could be obtained in recreational areas by sprays applied to leave a toxic deposit. Parts of three heavily infested parks at Fargo were treated between 22nd and 24th July with fine sprays consisting of emulsion concentrates diluted to contain 0.25 per cent. actual DDT, DDD [dichlordiphenyldichlorethane] or chlordane applied at a pressure of 150 lb. to the entire area including bordering vegetation to a height of 10 ft. It was already known that these insecticides would kill mosquitos if applied at 0.5 per cent. Counts of mosquitos alighting on the body, inactivated by a hot lantern or caught in small nets were made on the evenings of 28th July and 2nd and 10th August. The numbers taken in the areas treated with DDT, chlordane and DDD and (in brackets) in corresponding untreated areas were 2 (25), 34 (82) and 15 (21), respectively, at the first inspection, 12 (108), 38 (64) and 52 (33) at the second and 40 (70), 15 (56) and 26 (9) at the third. The last inspection in the control area for the DDD spray was made in bad weather. The relative abundance of the various species taken, which comprised three of *Aedes* and two of *Culex*, is shown in a table. Two of the species of *Aedes* are recorded from the State for the first time. Evidence is given of the favourable impression made on users of the parks, notably the one treated with DDD.

In another series of tests, four parks in the Grand Forks area were treated between 25th and 29th July with sprays containing 0.25 per cent. chlordane, DDT, DDD or benzene hexachloride in wettable powders applied at a pressure of 300 lb. to moisten the entire area and shrubby border. The temperature

exceeded 100°F. and there was a very high wind before the counts on 4th and 12th August, and very few mosquitos were taken in treated or untreated areas. From general observation, it was estimated that DDD and DDT gave control for one month and one week, respectively.

It is concluded that mosquitos can be effectively controlled in restricted areas such as golf courses and picnic areas. The 0.25 per cent. concentrations gave excellent results for one week. All sprays reduced the numbers of mosquitos for 10–14 days, after which they again became annoying. At large outdoor gatherings, a preliminary spraying of the area and shrubbery gave spectacular control. Benzene hexachloride, though effective, is not recommended for use near picnic areas on account of its persistent and objectionable odour. Mosquito abundance depends on local rainfall, which provides breeding places, and the prevailing winds, which blow the adults into mosquito-free areas. The most effective means of dealing with such situations is the application of sprays to leave a toxic residue at such intervals as may be necessary.

GREGSON (J. D.). **Benzene Hexachloride ("666") as an Acaricide.**—*Canad. Ent.* **78** no. 11–12 pp. 201–202. Guelph, Ont., 1947.

In experiments against *Dermacentor andersoni*, Stiles, in British Columbia, six cattle were sprayed over the back and neck with 2 quarts water to which had been added 15 cc. Triton X 100 and enough of a dispersible powder containing 50 per cent. benzene hexachloride to give  $\gamma$  isomer contents equivalent to 6, 3, 1.5, 0.75 and 0.375 lb. per 100 gals. After spraying, each animal was infested weekly with 20–45 ticks of both sexes. The highest concentration appeared to give complete protection for at least three weeks. The next protected one cow from male ticks for two weeks only, though none of 29 females became attached after three weeks, and it protected another animal from both sexes until the fourth week. The next two concentrations protected the cows for two weeks and the weakest spray for one. The duration of effectiveness may have been reduced by rain. The sprays did not harm the cattle.

In subsequent field tests, spraying the shoulders, neck and crown of the head of cattle with 1 pint of the strongest spray gave protection for two weeks. Tests on infested sheep indicated that concentrations as low as 0.023, 0.093 and 0.187 lb.  $\gamma$  isomer per 100 gals. are lethal to engorging ticks that have been feeding for one, three and five days, respectively. Ticks that had fed and dropped were resistant to 0.375 lb. per 100 gals., and though this and 0.187 lb. prevented them from ovipositing, lower concentrations did not.

FEDER (I. A.). **Tick Bite Pyrexia.**—*J. Amer. med. Ass.* **126** no. 5 pp. 293–294, 3 refs. Chicago, Ill., 1944.

In the course of military manoeuvres in Tennessee during May–June 1943, hundreds of soldiers admitted to hospital presented evidence of having been bitten by ticks. Many had symptoms such as dermatitis, attributable to secondary complications of the tick bites, a few had contracted tularaemia, and a few others had fever not caused by any of the recognised tick-borne diseases, associated in some cases with chills, headache or vomiting. Accounts are given of five such cases. In all of them one or more engorged ticks were found attached, and removal of these resulted in subsidence of the temperature and complete relief from the associated symptoms in 12–36 hours. The condition is referred to as "tick bite pyrexia". The few ticks that could be examined proved to be females of the genus *Dermacentor*. From analogy with tick paralysis, it is suggested that a toxin is injected by the tick, the effect of which becomes evident only after the tick is partially or fully engorged [*cf. R.A.E.*, B **32** 80], and that this toxin resides in the female and is associated with the production of eggs [*but cf. 32* 18, etc.].

**Liber Jubilaris J. Rodhain . . . à l'occasion de son soixante-dixième anniversaire.**  
—[2+] v+412 pp., frontis., 20 pls. (2 col.), 8 figs., many refs. Brussels,  
Soc. belge Méd. trop., 1947.

Six papers from this work are noticed below.

CIUCA (M.), BALIFF (L.) & CHELARESCO (M.). **Formes dégénérées de sporozoïtes dans l'infection expérimentale d'*A. maculipennis* v. *atroparvus* à *P. vivax* et à *P. falciparum***, pp. 131-146, 1 pl., 8 refs. The following is substantially the authors' summary. The tendency for degenerate forms of malaria sporozoites to occur in the salivary glands of Anopheline vectors, due apparently to environmental conditions and particularly to temperature, is discussed from the literature [cf. *R.A.E.*, B **22** 110; **24** 290; **25** 36]. Since 1933, the authors, in studies of the development in *Anopheles maculipennis* var. *atroparvus*, van Thiel, of strains of *Plasmodium vivax* and *P. falciparum* used in malaria therapy in Rumania, have observed abnormal forms in the glands, which they describe. These included thickened forms with retracted or contracted bodies and S-shaped and racquet-shaped forms. Tables are given showing the results obtained with various batches of mosquitos infected between September 1936 and March 1937; they were kept at 25°C. [77°F.] except during the time spent on their daily blood-meal. In the course of the rigorous winter, the temperature in the wards was not above 18°C. [64.4°F.]. Of 302 females of *A. m. atroparvus* infected with *P. vivax*, 107 had sporozoites in the salivary glands and 18 of them contained degenerate forms. Of 209 infected with *P. falciparum* 37 contained sporozoites in the salivary glands and in 12 some or all of these were degenerate. These results confirm the greater susceptibility of *P. falciparum* to develop abnormal sporozoites.

HAWKING (F.) & HUNT (R.). **The kochi Type of Malaria Parasite in Monkeys**, pp. 251-266, 4 pls. (2 col.), 1 fig., 20 refs. The authors describe the forms of a malaria parasite, corresponding to those usually designated *Plasmodium kochi*, discovered in 1946-47 in the peripheral blood of a baboon (*Papio papio*) from the Gambia, West Africa. The animal displayed no obvious ill effects from the infection. The forms in the blood were all mature or immature gametocytes; no schizonts were found in the blood or in portions of spleen, lung, liver or other tissues. Attempts to transmit the infection to monkeys of various species, by subinoculation of blood or portions of the tissues, were unsuccessful. An inoculated baboon developed a light *kochi* infection that extended over five months, but it might have been acquired in the Gambia. The parasite did not develop in *Anopheles quadrimaculatus*, Say, *A. maculipennis* var. *atroparvus*, van Thiel, *Aedes aegypti*, L., or a species of *Culex*; previous attempts by other workers to infect mosquitos [cf. *R.A.E.*, B **28** 148] have also proved unsuccessful.

It is recorded that P. C. C. Garnham has shown that monkeys in Kenya infected with *kochi* have small cysts on the liver containing schizonts, which he considers to represent the asexual stage of the parasite. By biopsy it was demonstrated that the liver of the infected baboon had similar cysts, although at a stage of invasion by giant cells and other phagocytes, which confirms Garnham's view. The literature concerning *kochi* is reviewed, and it is concluded that this parasite should be classified in *Haemoproteus* rather than in *Plasmodium*.

JADIN (J.) & D'HOOGHE (M.). **La fièvre rouge congolaise peut être aussi du typhus historique**, pp. 279-290, 2 graphs, 11 refs. The senior author isolated rickettsiae of murine typhus from cases of the disease known as Congo red fever at Coquilhatville in 1940-41 [cf. *R.A.E.*, B **33** 90] and from two cases at Costermansville in 1944-45 [cf. also **36** 144]. Several cases at Usumbura were studied in 1944-45, and two of them, although presenting the symptoms of Congo red fever, are considered from the reactions in inoculated guineapigs to have been epidemic typhus.

VAN DEN BERGHE (L.). **Isolement d'une souche d'érythroblastose transmissible de la poule (souche Anvers). Culture en tissus du virus et essais de transmission par moustiques**, pp. 351-357, 2 pls., 16 refs. An account is given of the isolation and maintenance of a filtrable virus producing erythroblastosis in hens in Antwerp in 1939-40. The means of transmission in nature is unknown; there is no evidence of its being transmitted by contact, and tests with ticks and lice gave negative results. The author fed groups of laboratory-reared females of *Anopheles maculipennis* var. *atroparvus*, van Thiel, *Aedes aegypti*, L., and *Culex pipiens*, L., on an infected hen and, 4, 7, 9, 11 or 15 days later, on young chickens. Infections developed in the chickens bitten by *A. m. atroparvus* on the first three of these days but not in those bitten later or in any of those bitten by the other mosquitoes.

VAN HOOF (L.), HENRARD (C.) & PEEL (E.). **Observations sur le *Trypanosoma brucei* produisant des infections naturelles dans une région infestée de *Glossina palpalis*, en l'absence de *G. morsitans***, pp. 359-380, 3 figs., 11 refs. An account is given of experiments with three strains of *Trypanosoma brucei* isolated in the west of the Belgian Congo from a dog at Thysville, a goat at Lokombe and a pig at Kingandu, all districts where *Glossina palpalis*, R.-D., is the predominant tsetse fly and *G. morsitans*, Westw., does not occur. Transmissions to laboratory animals were carried out by means of *G. palpalis* (cyclical) and injection of infected blood (mechanical), and the main passages are shown in diagrams. All the strains were not tested on all the animals, but it appeared that they were pathogenic to dogs and goats and only weakly so to pigs, in which the trypanosomes died out after some months. In pigs and goats, the indices of cyclical transmissibility were high [cf. R.A.E., B 25 212] and higher than those of *T. gambiense* whether the infections were new or old. These findings suggested that pigs might constitute a natural reservoir of *T. brucei* in the absence of game. Pigs that had recovered from the infection were not susceptible to *T. gambiense* transmitted by *G. palpalis*, but some infections with *T. rhodesiense* were obtained.

The distribution of the parasites in the salivary glands of the fly was similar to that already described [cf. 33 92]. The injection of human serum inactivated all three strains in guineapigs and protected against infection. Resistance to human serum was acquired by exposure to increasing subcurative doses, but tests on its persistence after cyclical or mechanical transmission gave inconclusive results. It is concluded that the three strains resembled a laboratory strain of *T. brucei* from East Africa studied in 1937 [25 212] in morphology and clinical behaviour.

Seven human volunteers were exposed to infection, and one transitory infection was obtained in a test in which a freshly isolated strain was transmitted cyclically. Negative results were obtained in other attempts to obtain cyclical transmission, in some of which trypanosomes resistant to human serum were used, and one to obtain mechanical transmission.

VAN THIEL (P. H.). **De dodende werking van enkele chemische stoffen in poedervorm op imagines en neten van *Pediculus capitis*** [The Toxicity of some Chemicals in Powders against Adults and Eggs of *P. humanus capitis*], pp. 381-393. In laboratory tests in Holland, batches of adults of *Pediculus humanus capitis*, Deg., were confined in closed petri dishes with hairs and 10 per cent.  $\alpha$ -chlormethylnaphthalene, 5 per cent. diphenylene oxide, 0.25 per cent. tetrachlordioxane, 1 per cent. polychlordioxane or Neocid (a Swiss preparation containing 5 per cent. DDT). All these powders gave complete mortality in 19 hours, but the best results were obtained with diphenylene oxide in talc and polychlordioxane in talc and chalk; the former gave almost complete mortality in four hours and the latter, though somewhat less effective, was far more rapid in action than Neocid. Further tests showed that a mixture of equal

parts of 1 per cent. polychlordioxane and 5 per cent. diphenylene oxide was as effective as 5 per cent. diphenylene oxide alone and superior to 1 per cent. polychlordioxane alone and to Omyl (a Dutch preparation containing 10 per cent. DDT), which was equal in effectiveness to an American DDT powder. Zuiverrein (a preparation stated to contain 12.7 per cent. naphthalene) gave complete mortality in three hours.

To test the action of these preparations, lice were left for varying periods on hairs that had been rubbed in the powders and were then transferred to untreated hairs in closed petri dishes. The lice that had been in contact with DDT for one minute were nearly all dead in ten hours, whereas contact for ten minutes with 50 per cent. diphenylene oxide, 1 per cent. polychlordioxane or Zuiverrein killed less than half in the same time. From further tests in open and closed dishes, it is concluded that the last three materials act as fumigants rather than as contact insecticides, and that they are likely to be effective in practice only if the hair is completely covered after treatment and allowed to remain so all night. Moreover, lice that escape survive, and this is not the case if DDT is used. The eyes of persons to be treated should be bandaged before application of Zuiverrein.

Eggs of *P. h. capitis* were left in contact with the powders under test for 20 or 36 hours at 29°C. [84.2°F.], and after being washed and dried were kept in petri dishes for ten days at the same temperature. The results, which were assessed by examining the eggs microscopically, showed that DDT (Neocid and Omyl) had no ovicidal effect; 5 per cent. diphenylene oxide and 1 per cent. polychlordioxane, separately and in admixture (1:1), gave high mortality in 36 hours but very little in 20, and Zuiverrein killed all the eggs exposed for 36 hours and almost all those exposed for 20, but was less effective in 12 hours. Since, in practice, it is not convenient for the head to be covered for more than a night, these preparations are unlikely to be of value in destroying the eggs.

#### PAPERS NOTICED BY TITLE ONLY.

- LEWIS (D. J.). **The Egg of *Anopheles squamosus* Theobald** [from the Sudan].—*E. Afr. med. J.* **23** no. 4 p. 118, 1 fig. Nairobi, 1946.
- DODGE (H. R.). **Identification of *Culex* Males** [of Georgia] **under low Magnification**.—*Ann. ent. Soc. Amer.* **39** no. 1 pp. 140–142. Columbus, Ohio, 1946.
- WIESMANN (R.). **Untersuchungen über die Eintrittspforten des Dichlordiphenyl-trichloraethan (DDT) in den Insektenkörper**. [Investigations on the Sites of Penetration of DDT into the Body of an Insect.].—*Verh. schweiz. naturf. Ges.* **126** pp. 166–167. Aarau, 1946. [See *R.A.E.*, A **37** 115.]
- WIGGLESWORTH (V. B.). **The Epicuticle in an Insect, *Rhodnius prolixus* (Hemiptera)**.—*Proc. roy. Soc. (B)* **134** no. 875 pp. 163–181, 7 figs., 25 refs. London, 1947. [See *R.A.E.*, A **37** 110.]
- BEAMENT (J. W. L.). **The waterproofing Process in Eggs of *Rhodnius prolixus* Stål**.—*Proc. roy. Soc. (B)* **133** no. 873 pp. 407–418, 2 figs., 15 refs. London, 1946. [See *R.A.E.*, A **37** 110.]
- BEAMENT (J. W. L.). **The Penetration of the Insect Egg-shells. I.—Penetration of the Chorion of *Rhodnius prolixus* Stål**.—*Bull. ent. Res.* **39** pt. 3 pp. 359–383, 12 figs., 19 refs. London, 1948. [See *R.A.E.*, A **37** 110.]

EARLE (K. V.). **Pyrexia associated with Tick-bite.**—*J. trop. Med. Hyg.* **49** no. 1 pp. 14–15, 1 ref. London, 1946.

The author records the case of a Canadian working in a heavily tick-infested district of Ecuador who was seen in January 1945, when he had been suffering from fever, chills, malaise and vague body pains for three days. Many old tick bites were observed on his body, but no signs of any disease organism or abnormality were found. Two days later a moderately engorged tick was found and removed, and a few hours later the patient returned to normal health. The similarity between this case and those reported by Feder [*R.A.E.*, B **37** 69] is pointed out, but the tick found was a nymph of the genus *Amblyomma*, so that the toxic principle would appear not to be confined to adult females.

TOVAR (R. M.). **Infection and Transmission of *Brucella* by Ectoparasites.**—*Amer. J. vet. Res.* **8** no. 26 pp. 138–140, 6 refs. Chicago, Ill., 1947.

In view of the frequent occurrence in herds of cattle, goats and pigs of outbreaks of brucellosis, of which the mode of transmission cannot be explained, the occasional occurrence of brucellosis in man and the experimental infection of cockroaches and flies with *Brucella abortus* [*R.A.E.*, B **31** 98], experiments were carried out in Mexico to ascertain whether *Boophilus annulatus*, Say, *Amblyomma cayennense*, F., *Cimex lectularius*, L., and *Ctenocephalides felis*, Bch., play any part in the conservation and transmission of the organisms. The Arthropods were collected and kept under observation for a month to ensure that no previous infections were present. Suspensions of *Brucella melitensis*, *B. abortus* and *B. suis* were injected subcutaneously and intraperitoneally into guineapigs and mice and 24 hours later ticks, bed-bugs and fleas were placed on them, 20 ectoparasites being used for each species of *Brucella*. Ticks required 4–8 days to fix, engorge and drop off; bed-bugs and fleas fed within a few minutes. Daily cultures were made of the faeces of all the lots, and cultures of transverse sections of ectoparasites were made every five days. The cultures of faeces showed that each species of Arthropod can be infected with any of the three species of *Brucella*. Of ten examples of each kept isolated after the infective meal, eight of *Boophilus*, six of *Amblyomma*, five of the bugs and five of the fleas excreted infected faeces. Fleas began to eliminate *Brucella* in the faeces from the third day after the infective meal, bed-bugs from the sixth day and ticks from the tenth. Ticks and bed-bugs were still eliminating them after three months. *B. suis* was the earliest species to be eliminated, and the Arthropods infected with it had a higher rate of mortality than the others. Infection was also demonstrated in the cultures of sections of the infected ectoparasites, and smears from them showed epithelial cells full of small organisms with a morphology typical of *Brucella*, whereas microscopic study and cultures of the non-infected individuals gave negative results. When infected examples were allowed to feed on healthy animals, only the two species of ticks transmitted infection, and they did so only when the meal was not interrupted; three of six guineapigs were infected in this way. Three of six suspensions of eggs from infected ticks that were injected subcutaneously into guineapigs produced infection [*cf.* also **35** 159].

Following these results, suspensions of ten lots of *C. lectularius* collected in Mexico City from the beds of brucellosis patients and five lots of *Boophilus annulatus* from a region in the State of Guanajuato where brucellosis is endemic and rather frequent were injected subcutaneously into guineapigs; two lots of *C. lectularius* proved to be infected with *Brucella melitensis* and one of *Boophilus* with *Brucella abortus*. Two of the other lots of ticks produced fatal infections in guineapigs, but the causal agent, which was not *Brucella*, was not identified.

**Control of Midges. An interim Report of a Sub-committee of the Scientific Advisory Committee, Department of Health for Scotland.**—11 pp. Edinburgh, H.M.S.O., 1946. Price 2d. **The second Report on Control of Midges by a Sub-committee of the Scientific Advisory Committee.**—11 pp., 2 figs., 5 refs. 1948. Price 4d.

The first of these reports on investigations on *Culicoides* in Scotland in 1945 and 1946 contains a Report on Midge Repellents, by E. Cameron (pp. 4-8), and A Survey of Scottish Midges by A. E. Cameron, J. A. Downes, G. D. Morison & A. D. Peacock (pp. 9-11). In the work on repellents, dimethyl phthalate, the only suitable material available at the time, was made up in various forms for application to the skin, the most satisfactory results being obtained with pastes and emulsions. Some representative formulae are given in an appendix. A few of the most satisfactory preparations were tested in the field, mainly in Inverness-shire and Ross-shire, in hay fields, cattle sheds, forest nurseries and plantations and other sites where heavy midge attacks were experienced, and gave good protection for several hours [cf. R.A.E., B 35 95]. In many cases the midge attacks tended to die down after about 30 minutes. It was found that a dimethyl-phthalate content of at least 35-40 per cent. was essential for effective protection, but a too high proportion sometimes scorched tender skins. None of the preparations remained stable for more than a few months. Veils of wide-meshed hospital gauze impregnated with dimethyl phthalate gave complete protection from midges for as long as the attack lasted. *Culicoides impunctatus*, Goetgh., was found to be by far the most abundant species. Midges were generally present during June-September and were most troublesome in July and August, often preventing people from remaining out of doors. Attacks were most numerous in the morning and evening but occurred at all times of day and under diverse weather conditions.

The survey of Scottish midges covered 18 counties. A list is given of the 15 species identified, three of which had not previously been recorded from Scotland, with notes on their distribution and habits, where known. The commonest were *C. impunctatus*, *C. obsoletus*, Mg., *C. griseus*, Edw., *C. heliophilus*, Edw., and *C. pulicaris*, L. [cf. 35 95], of which the first outnumbered all others taken together, was very widely distributed, and was responsible for 75-100 per cent. of all bites. It was commonest in rough, open country and reached an abundance of 50,000 per acre at peak periods. The adults emerged in late May, occurred in large numbers throughout June, July and August, and diminished in mid-September.

The second report contains notes on the habits of the midges, based partly on the literature, and an account of further work with dimethyl phthalate. Midge larvae occur in a variety of damp sites, and box traps designed to catch the emerging adults were set up on damp soil of various kinds in four districts. *C. impunctatus* was rarely recovered, but *C. obsoletus* and *C. pulicaris* were fairly numerous in leaf mould and damp leaves and *C. pallidicornis*, Kieff., and *C. heliophilus* were also fairly plentiful in acid peat soil. The observations indicated that *C. impunctatus* and *C. pallidicornis* have one generation a year and *C. obsoletus* and probably *C. heliophilus* two. *C. impunctatus* was again responsible for the great majority of attacks on man, and evidence was obtained that this and other species also feed on cattle. Different types of reactions to midge bites are described. The presence of three further species is recorded.

Continued experiments with dimethyl phthalate were mainly directed to testing impregnated head veils, gauntlets and oversocks made of netting with a mesh of  $\frac{4}{16} \times \frac{5}{16}$  in. The veils gave full protection for several days and retained their efficacy for 5-6 days when carried loosely in the pocket and for at least 10-14 days if kept in a tin. The other garments gave good protection but are likely to be less widely used. Dimethyl phthalate appeared to repel ants and

*Simulium* spp., but was useless against non-biting flies and *Trombicula autumnalis*, Shaw [cf. 35 52].

FOX (I.). **A Review of the Species of Biting Midges or *Culicoides* from the Caribbean Region (Diptera : Ceratopogonidae).**—*Ann. ent. Soc. Amer.* 39 no. 2 pp. 248–258, 11 figs., 14 refs. Columbus, Ohio, 1946.

A key is given to the females of the 18 species of *Culicoides* known from the Caribbean region, exclusive of Mexico. Six are described as new, and records are given of the distribution of all.

PFADT (R. E.). **Effects of Temperature and Humidity on larval and pupal Stages of the Common Cattle Grub.**—*J. econ. Ent.* 40 no. 3 pp. 293–300, 10 refs. Menasha, Wis., 1947.

The following is based on the author's introduction and summary. Both *Hypoderma lineatum*, Vill., and *H. bovis*, Deg., are major pests of cattle in Wyoming. At Laramie, adults of *H. lineatum* emerge in May and live for only a short time, and the eggs hatch in 3–6 days. The larvae at once penetrate the skin, reach the back in February and drop to the ground in March or April. The free larvae pupate in 1–4 days, and the pupal stage lasts 40–50 days. The life cycle of *H. bovis* is similar, but all stages appear about a month later so that the free larvae and pupae are not exposed to the low temperatures that are believed to be a lethal factor in the life of *H. lineatum*.

A study of the effects of temperature and relative humidity on the development of free larvae and pupae of *H. lineatum* was made under both field and controlled laboratory conditions. A high survival rate of pupae was found to obtain under field conditions, even when mature larvae obtained from cows brought from Colorado were placed in the field up to 18 days before the normal dropping period. Low temperature tests with exposure periods of 1–8 hours showed that some larvae survive a temperature of  $-20^{\circ}\text{C}$ . [ $-4^{\circ}\text{F}$ .], but none survive  $-25^{\circ}\text{C}$ . [ $-13^{\circ}\text{F}$ .]. Of a group of larvae sprinkled with one or two drops of water each, many subjected to  $-5^{\circ}\text{C}$ . [ $23^{\circ}\text{F}$ .] were frozen and killed [cf. *R.A.E.*, B 34 16]. The survival rates of pupae reared at constant temperatures of 15, 20, 25 and  $30^{\circ}\text{C}$ . [ $59$ ,  $68$ ,  $77$  and  $86^{\circ}\text{F}$ .] were 44, 81, 33 and 0 per cent., respectively. The pupal period lasted 43.8 days at  $15^{\circ}\text{C}$ ., 19.8 days at  $20^{\circ}\text{C}$ . and 12 days at  $25^{\circ}\text{C}$ . Groups of pupae were reared at constant relative humidities of 0, 32, 56, 76 and 100 per cent., one series at  $20^{\circ}\text{C}$ . and one at  $25^{\circ}\text{C}$ . Very little difference was found in the length of the pupal period and in the survival rate at relative humidities of up to 76 per cent.; development was slightly delayed at 100 per cent. and mortality greatly increased [cf. 27 100].

The conclusion was reached that little aid in control of *H. lineatum* can be expected in Wyoming from inclement weather during the dropping period. Although larvae sprinkled with water were killed in the laboratory by temperatures as high as  $-5^{\circ}\text{C}$ ., most dry larvae survived at  $-15^{\circ}\text{C}$ . [ $5^{\circ}\text{F}$ .] Ground temperatures have been shown not to fall below  $-13^{\circ}\text{C}$ . [ $8.6^{\circ}\text{F}$ .] after 1st February at Laramie in the years in which data have been taken. Dropping probably starts later than 1st February in all parts of Wyoming.

RUDE (C. S.). **DDT to control the Gulf Coast Tick.**—*J. econ. Ent.* 40 no. 3 pp. 301–303, 1 ref. Menasha, Wis., 1947.

*Amblyomma maculatum*, Koch, is a serious pest of livestock in the region bordering the Gulf of Mexico, the most important consequence of infestation being the predisposition of the host to attack by *Cochliomyia hominivorax*, Coq.

(*americana*, Cush. & Patt.) [cf. *R.A.E.*, B 34 164]. Observations in 1942-45 indicated that systematic mowing of pasture to prevent rank growth helps to keep populations of the tick low. During the same period, experiments were made in Texas to develop a dressing that would kill the ticks and protect the animals from reinfestation for some time. From 1943 onwards, tests were made with DDT on cattle. In 1943, a preparation made by adding 2 per cent. DDT to an adhesive mixture gave some reduction in the number of ticks present and a similar preparation containing 5 per cent. DDT a much greater reduction [32 200]. After various modifications designed to improve consistency, one preparation recently noticed [37 66] was devised in 1945 and proved satisfactory under conditions in southern Texas. It is prepared by mixing together the DDT and dibutyl phthalate and stirring them into the resin and methyl abietate after these have been heated together until the resin is liquefied and cooled to 125°F. or less. It should be liberally rubbed with the bare hands into the inside and outside of the outer ears and around the base of the horns as soon as ticks become numerous and again when they resume attack. Under conditions of very heavy infestation in 1945, it gave good initial kill and provided protection from serious reinfestation for 3-6 weeks. Only 33 cases of infestation by *C. hominivorax* as a result of tick injury occurred in 3,280 treated cattle, whereas nine out of 25 untreated animals became infested by the fly. In a flock of 73 sheep, which were estimated to have an average of eight ticks per ear when treated, ticks were found on only four sheep four weeks later, one having five ticks and three one tick each. A thicker mixture than that finally adopted was tried on horses but caused shedding of the hair from the ears and some skin injury.

GOUCK (H. K.) & SMITH (C. N.). **DDT to control Wood Ticks.**—*J. econ. Ent.* 40 no. 3 pp. 303-308, 2 refs. Menasha, Wis., 1947.

The following is mainly based on the authors' summary. Experiments on the effectiveness of DDT for the control of *Dermacentor variabilis*, Say, were made in roadside plots one acre in area at Martha's Vineyard, Massachusetts, in 1945. Technical DDT at 2.5 lb. per acre in emulsified oil solution gave uniformly satisfactory control, keeping populations at less than about 5 per cent. of their original level throughout the observation period of 10-22 days. At 1-2 lb. per acre, control was satisfactory in some plots but not in others. Apparently, the dosage required to insure effective control in every instance would be over 2 lb. but probably not more than 3 lb. DDT per acre [cf. *R.A.E.*, B 35 25].

In woodland plots 0.5-1 acre in area, near Savannah, Georgia, nymphs and adults of *Amblyomma americanum*, L., were controlled throughout the season of activity, as long as 125 days, with 1 lb. DDT per acre used in emulsified oil solution [cf. 37 66]. This dosage was effective whether applied in 50 or 100 U.S. gals. water. Sprays prepared with soluble pine oil, Velsicol AR 60 (chiefly di- and tri-methyl naphthalenes) and xylene (the last two emulsified with Triton X-100) were almost equally effective and a dust of 10 per cent. DDT in pyrophyllite was only slightly less so. The season of larval activity began about a month after the last treatments were applied, and clusters of living larvae were collected in the treated plots. DDT sprays applied from aircraft at Bull's Island, South Carolina, in 1946 were less effective than ground treatment against *A. americanum*, the only species present in considerable numbers. Tick abundance was reduced more slowly than by ground applications, but after six weeks control was about 85 per cent. complete in most of the plots.

Applications of about 1 lb. DDT per acre in emulsified oil solution gave excellent control of *Ixodes scapularis*, Say, in roadside plots for periods as long as 102 days.

BRESCIA (F.) & WILSON (I. B.). **Larvicidal Treatment of large Areas by Ground Dispersal of DDT Aerosols.**—*J. econ. Ent.* **40** no. 3 pp. 309–313, 1 ref. Menasha, Wis., 1947.

An area of about 1,500 acres on the coastal plain of Guadalcanal, Solomon Islands, was treated with DDT aerosols four times between 29th December 1944 and 1st February 1945 for the control of mosquito larvae, with a generator similar to that originally devised for use against the adults [*R.A.E.*, B **36** 83]. The breeding places consisted of ditches, ruts, edges of cane swamps, bomb craters and other pits, marshy areas and puddles. The local vector of malaria was *Anopheles farauti*, Lav., and the predominant non-Anopheline was *Culex annulirostris*, Skuse. The emulsion for the aerosol consisted of 25 U.S. gals. SAE no. 50 oil, 15 U.S. gals. diesel oil, 8 U.S. gals. xylene, 1 U.S. gal. emulsifier (Tween 85), 30 lb. DDT (10 per cent. of the weight of oil) and 27 U.S. gals. water. The generator was operated at a temperature and pressure to produce particles having a mass average diameter of 16–20 microns. Meteorological conditions were generally poor. Reductions of 94–100 and 99 per cent. in the numbers of *A. farauti* and of other mosquitos, respectively, were recorded after each treatment. Mechanical operation of the generator was consistently satisfactory. Comparison with standard hand and power spray treatments, which were tried later, showed the aerosol to give better control. As little as 0.5 U.S. quart of the mixture of 10 per cent. DDT and oil per acre controlled larvae to at least 2,000 ft. downwind, but 1 U.S. quart is recommended to allow a margin of safety. This is much in excess of the amount required for hand spraying (0.2 U.S. quart of 5 per cent. DDT in oil), but aerosols were about six times more economical in use of man-power. It is concluded that the generator should be useful in effecting rapid control without the necessity for seeking out individual breeding places. The undeposited portion of the aerosol kills adult mosquitos over large areas.

*Culex* larvae in waste-water ditches containing considerable amounts of soap were not controlled by the standard treatment or the ordinary aerosol treatment, but were eventually satisfactorily dealt with by a specific application of aerosol with the generator relatively close (20–200 ft. upwind).

BRESCIA (F.) & WILSON (I. B.). **Treatment of Native Villages with the Aerosol Generator.**—*J. econ. Ent.* **40** no. 3 pp. 313–316, 1 ref. Menasha, Wis., 1947.

A single exterior treatment by ground machine in March 1945 of two native villages on the shores of Big Florida, Solomon Islands, with an aerosol of DDT in oil having an average mass particle diameter of 10 microns at a dosage of about 5 lb. DDT per 1,000 ft. of front, the front extending 1,000 ft. beyond the limits of the village, killed adults of *Anopheles farauti*, Lav., both inside and outside the thatched huts and gave protection from reinfestation for at least five days in one village and one day in the second. The difference was largely due to the more extensive breeding area in the neighbourhood of the second village and unsatisfactory control of larvae. Treatment had to be made during the day, but wind velocity was adequate. To obtain an appreciable protective period in a village like the second, which was bordered by a jungle in which breeding places extended beyond 1,000 ft. behind the village, about 20 lb. DDT per 1,000 ft. of front should be used and the front should be extended 2,000 ft. beyond the edges of the village. For a village such as the first, where the breeding sites were all within 1,000 ft. of the village but there was broken terrain, 10 lb. DDT per 1,000 ft. of front with the front extending for 2,000 ft. beyond the village should increase the protective period considerably. The treatment very considerably reduced populations of *Armigeres malayi breinli*,

Tayl., and *Aedes quasiscutellaris*, Farner & Bohart, in the jungle behind this village for several days and control of *Anopheles* larvae was satisfactory, fourth-instar larvae not being present in appreciable numbers until the eighth day.

BRESCIA (F.) & WILSON (I. B.). **Aerosol Generator as used for Sand Fly Control.**—*J. econ. Ent.* **40** no. 3 pp. 316-319. Menasha, Wis., 1947.

Concurrently with tests of DDT aerosols dispersed from a ground generator for the control of mosquito larvae [*R.A.E.*, B **37** 77], an investigation was made of their effectiveness against *Styloconops albiventris*, de Meij., which breeds in the moist sand of the high-tide zone on the beaches of Guadalcanal, Solomon Islands, and had become a nuisance at a rest camp. Very little is known of the life-history of this Ceratopogonid. The adults were not attracted to lights and did not enter dwellings at night. There was a peak of biting at 8.30 a.m. but practically no biting between 10 a.m. and 7.30 a.m. next day. No apparent preference for sunshine or shade while on the wing was noticed, but activity was discouraged by winds of more than 5 miles per hour.

The bare beach in the area in which control was attempted was generally 15-20 ft. wide at low tide. There was a zone of loose dry sand supporting a low plant growth immediately inshore, and the encampments were behind this among scattered palms. Three types of treatment were compared; the rates of application of the emulsion (given in brackets) are the outputs of oil containing 10 per cent. DDT per 1,000 ft. of beach. In the first, tested on 6th January 1945 with a land breeze of 1-1.5 miles per hour, an aerosol with particles 16 microns in diameter was released (at 7.4 U.S. gals.) against the adults from a road 25-700 ft. from the beach and the beach was then sprayed for the control of larvae (at 4.8 U.S. gals.) with particles about 300 microns in diameter obtained by operating the generator at a much lower temperature. The aerosol was applied at 8 a.m., 6.10 a.m., when signs of biting were first noticed, having been found too early. In the second treatment, applied on 1st February, half the test area received the larvicidal spray (at 5 U.S. gals.), and the whole of it received an aerosol with 10-micron particles released from the road (at 5.3 U.S. gals.) between 7.45 and 8.45 a.m. with a land breeze of 2-3.5 m.p.h. The third treatment was made on 8th February and consisted in the release (at 7.1 U.S. gals.) of an aerosol with 16-micron particles at low tide between 9.45 and 10.40 a.m. from the seaward side of the beach to give maximum dosage and deposition in the region near high-water mark where the adults were believed to rest. There was a sea breeze of 3.5-5 m.p.h. The three types of treatment were about equally effective, all giving some 90 per cent. reduction in biting, but the aerosol with the smallest particles was comparatively slow in action when used alone. Protective periods were at least four days for all treatments, but the periodicity of treatment is affected by the rate of breeding, which is irregular, as well as by the migratory rate.

The results of a test in which two traps were set up over the ground in an area where biting counts were consistently high, one before and one after the ground was treated with an aerosol with particles 16 microns in diameter, showed that the deposited aerosol was very effective in controlling larvae. The place was washed by the sea water and remained submerged during certain high tides.

The control measure recommended on the basis of these tests is to treat the beach from the seaward side at low tide with 7-7.5 U.S. gals. of 10 per cent. DDT in oil per 1,000 ft. of front projected as an aerosol with a particle diameter of 16 microns. If the wind speed is more than 5 m.p.h., larger particles should be used for the control of larvae. The treatment should extend at least 500 ft. beyond the beach line to be controlled.

VOGT (G. B.). **Salinity Tolerance of *Anopheles quadrimaculatus* and Habitat Preference of *A. crucians bradleyi*.**—*J. econ. Ent.* **40** no. 3 pp. 320–325, 6 refs. Menasha, Wis., 1947.

The following is substantially the author's summary. The distribution of mosquito larvae and pupae in Deep Creek, St. Mary's County, Maryland, is described for the summers of 1944 and 1945 with reference to salinity, pH and types of vegetation. Deep Creek was well suited for studies of salinity tolerance since it provided uniform breeding conditions, and a wide range of salinities that underwent little if any short-period fluctuations but were subject to gradual seasonal changes. At this locality, with relatively constant salinities, the salinity tolerance for continuous substantial occurrence of immature stages of *Anopheles quadrimaculatus*, Say, was found to be as high as 2,900 parts per million soluble chlorides (9.4 per cent. seawater). At relatively constant salinities between 4,400 and 6,300 p.p.m. soluble chlorides, *A. quadrimaculatus* was never found, evidently because the critical point of its salinity tolerance was exceeded.

On one occasion, following approximately a 13-fold increase in salinity over a period of 36 days, considerable numbers of larvae and pupae of *A. quadrimaculatus* were found at concentrations as high as 5,200 p.p.m. soluble chlorides (16 per cent. seawater). In this case, it is indicated that the individuals found were survivors that had begun to develop at lower salinities.

*A. crucians bradleyi*, King, and *Culex salinarius*, Coq., were the only other mosquitos observed breeding in Deep Creek. Both seemed to be distributed with little regard to salinity, but were found where grasses and rushes provided emergent vegetation of appreciable height. An exception was noted in the spring and autumn when larvae were found in the exposed water surface associated with a coverage of sago pondweed (*Potamogeton pectinatus*) and green algae.

GJULLIN (C. M.). **Effect of Clothing Color on the Rate of Attack of *Aedes* Mosquitoes.**—*J. econ. Ent.* **40** no. 3 pp. 326–327, 1 fig., 3 refs. Menasha, Wis., 1947.

The following is virtually the author's summary. The effect of clothing colour on the rate of attack of several species of *Aedes* mosquitos was tested in the north-western United States. *A. lateralis*, Mg., preferred black, blue, red, tan, green, yellow, and white in the order named, whereas *A. dorsalis*, Mg., preferred black, blue, red, green, tan, yellow, and white. A group of mixed species consisting of *A. hexodontus*, Dyar, *A. communis*, Deg., and *A. aboriginis*, Dyar, preferred black, red, tan, blue, green, yellow and white. Mosquito attack can be greatly reduced by the use of non-attractive clothing colours, such as white and yellow, in areas where these species are present.

The colour preferences of *A. dorsalis* follow the same sequence as the spectral reflectance values of the test colours in a wave-length range from 400 to 750 millimicrons, whereas the preferences of *A. lateralis* follow the sequence in the 254- to 750-millimicron range. These correlations suggest that colours are chosen on the basis of their spectral reflectances, and that these species lack the ability to distinguish colours.

CUTKOMP (L. K.). **Residual Sprays to control *Anopheles quadrimaculatus*.**—*J. econ. Ent.* **40** no. 3 pp. 328–333, 3 figs., 7 refs. Menasha, Wis., 1947.

Laboratory and field tests of the effectiveness of residues deposited by various sprays against females of *Anopheles quadrimaculatus*, Say, and factors influencing it were carried out in 1945 and 1946 in the Tennessee Valley. The insecticides used in the laboratory were DDT, BHC (benzene hexachloride)

and chlordane (Velsicol 1068) [*R.A.E.*, B **35** 50], all applied in solutions or emulsified solutions. A dispersible DDT was also used. The insecticides were brushed on the dry surface at 100 mg. active ingredient ( $\gamma$  isomer in the case of BHC) per sq. ft. The field tests involved DDT, pyrethrins, BHC, a mixture of DDT and BHC (9 : 1), chlordane and toxaphene [**36** 198], applied in emulsified solution. The methods used are described. Knockdown time was used and gave an index of toxicity of most insecticides.

The following is substantially the author's summary of the results. The type of surface was highly important. After 29 weeks, DDT was more effective than BHC or chlordane applied on a beaver wall board, but BHC had acted more rapidly than DDT when the deposits were not so old. DDT was less effective than BHC on a surface of red clay subsoil. The toxicity of chlordane on clay was very low after one week. All three materials were much more effective on wall board than on clay.

The formulations of insecticides did not appear to be so important as the nature of the compound under test. The wettable or dispersible type of DDT and solutions of DDT and BHC did not differ markedly in 16 weeks on wall board; after 29 weeks the wettable DDT had a somewhat more rapid effect. Both DDT and BHC were more effective in emulsions than in unemulsified solutions on clay, but unemulsified solutions appeared more satisfactory than emulsions on wall board.

Field tests in occupied and unoccupied structures indicated toxicity lasting three months or longer with DDT (applied as a spray or incorporated in wallpaper), BHC, the 9 : 1 mixture of DDT and BHC, toxaphene and pyrethrins. At this time, recoveries following knockdown were evident only with pyrethrins. Chlordane may be effective for this period under certain conditions. Pyrethrins and BHC produced the most rapid knockdown through the test period of three months. Under certain conditions, both DDT and BHC show toxicity for a year or more. This prolonged effect was not shown by pyrethrins or chlordane.

The reaction patterns differed when mosquitos were exposed to DDT, toxaphene and BHC. The irritant effect produced by toxaphene is much less apparent than that produced by DDT. All test materials produced more rapid effects on male than on female mosquitos. Observations on other biological factors indicate that older females are more susceptible than younger ones and also that females that have not had a blood-meal are more susceptible than those that have [*cf.* **34** 201].

CORY (E. N.) & LANGFORD (G. S.). **Fly Control in Dairy Barns and on Livestock by Cooperative Spray Services.**—*J. econ. Ent.* **40** no. 3 pp. 425-426. Menasha, Wis., 1947.

Co-operative services for the control of flies on farms by the application of DDT sprays to buildings and livestock, mostly dairy cows, were tried in Maryland from the early winter of 1946 and were judged by almost all the farmers taking advantage of them to give better results at lower cost than could be obtained by individual effort. Organisation and costs are discussed. DDT wettable powder was used throughout at 1 per cent. actual DDT for all the barn spraying and usually at the same strength on the animals, as this was more economical than changing to a weaker spray. Pressure of 400-500 lb. was mostly used and gave a deposit effective for an average period of ten weeks in barns and for as much as six weeks on animals. A maximum of three applications gave effective results for the whole season. Only very short protection was given by sprays applied to animals with hand equipment.

In tests in which benzene hexachloride, used as a 50 per cent. wettable powder prepared from material containing 10 per cent.  $\gamma$  isomer, was compared weight

for weight with DDT, excellent results were obtained with it. Knockdown was more rapid than with DDT and the action of the residue in barns and on animals seemed about equally effective and lasting. It was not applied to dairy cows or premises because of its odour.

LINDQUIST (A. W.), MADDEN (A. H.) & WILSON (H. G.). **Pre-treating House Flies with Synergists before applying Pyrethrum Sprays.**—*J. econ. Ent.* **40** no. 3 pp. 426-427, 5 refs. Menasha, Wis., 1947.

An account is given of experiments in which house-flies [*Musca domestica*, L.] in small wire cages were exposed in a 100 cu. ft. testing chamber to mist sprays of 0.1 per cent. pyrethrins in kerosene, followed or preceded at intervals of 30 seconds or 1, 2 or 4 hours, by sprays containing 5 per cent. of a synergist in cyclohexanone. For comparison, other flies were exposed to sprays containing pyrethrins, synergist or both. The synergists were a commercial product containing a mixture of certain derivatives of piperonyl cyclohexanone, applied at a dosage of 0.5 ml. per 100 cu. ft., and sesame-oil concentrate and N-isobutylundecyleneamide, both applied at 0.7 ml. The dosage of pyrethrins in each treatment was the same as that of the synergist. Knockdown counts were made after 10, 30 and 60 minutes.

Pyrethrins alone and synergists alone were ineffective, as was also treatment with pyrethrins followed by a synergist when the interval was one hour or more. When pyrethrins were followed by a synergist after 30 seconds, the results were fair. They were about the same for the reverse procedure in the case of N-isobutylundecyleneamide, but better with the other synergists. A high knockdown followed the application of pyrethrins 1, 2 and 4 hours after a synergist, the one-hour interval giving the best results in many cases. In a supplementary test in which the pyrethrins were applied 1, 7, 24, 48 and 72 hours after the sesame-oil concentrate, the knockdown after 10 minutes was as satisfactory at 24 hours as it was at 1 hour, but was slight at 48 and 72 hours. A mixture of synergist and pyrethrins was somewhat less effective than an application of synergist followed by one of pyrethrins when the synergist was piperonyl cyclohexanone derivatives, but about equally effective when the other synergists were used. In a series of tests in which DDT was used instead of pyrethrins with intervals between treatments of 30 seconds and one hour, the synergists did not increase knockdown or kill whether applied before or after the DDT.

TILLER (R. E.) & CORY (E. N.). **Effects of DDT on some Tidewater Aquatic Animals.**—*J. econ. Ent.* **40** no. 3 pp. 431-433. Menasha, Wis., 1947.

In tests carried out in Maryland in which quantities of DDT greatly in excess of those likely to be used in mosquito control programmes were applied in an oil spray and a water-dispersible emulsion to a pond near tidal water and to tidal areas with slight and strong currents, no damage attributable to the insecticide was done to fish, frogs, crabs or oysters. The authors consider, however, that the data do not justify conclusions regarding all the effects of DDT as it might be used in large-scale spraying operations.

BRESCIA (F.). **Effect of Concentration of DDT in Oil Aerosols on Toxicity to Mosquito Larvae.**—*J. econ. Ent.* **40** no. 3 p. 441, 1 ref. Menasha, Wis., 1947.

In the course of work with a thermal aerosol generator [*R.A.E.*, B **36** 83], it became necessary to compare the toxicity to mosquito larvae of an aerosol composed of 10 per cent. DDT in droplets of non-volatile oil with that of one

composed of droplets of DDT solution supersaturated by evaporation of the solvent. Larvae of *Aedes aegypti*, L., were exposed in a room for periods ranging from 0.5 to 15 minutes to uniform concentrations of DDT in two types of aerosols from different emulsions. The first consisted of non-volatile oil droplets containing 10 per cent. DDT and the second of a highly supersaturated solution containing 55 per cent. DDT in an emulsifier. The two types of aerosols were equally toxic, giving complete kill with exposures of one minute or more and 95 and 90 per cent. kill, respectively, with the shortest exposure. In field work, however, DDT aerosols produced from volatile oils are not likely to be effective against mosquito larvae if the wind speed is greater than 3 miles per hour, as evaporation will probably reduce the initial particle diameter to a size at which deposition will be inadequate [cf. 36 83-84]. This would not prevent their effective use against adult mosquitos.

CUTKOMP (L. K.). **Thermal Decomposition of DDT dispersed in Water.**—*J. econ. Ent.* 40 no. 3 pp. 444-445, 1 fig., 5 refs. Menasha, Wis., 1947.

As it had been shown that a dispersion of pure DDT in water autoclaved to prevent bacterial contamination, which is a factor influencing toxicity to mosquito larvae, was at least 40 per cent. less toxic than a dispersion kept at room temperature, chemical studies were made to explain such a difference. The following is substantially the author's summary of the results. Dilute dispersions of DDT in water heated to above 90°C., boiled or autoclaved at pressures corresponding to an average of 121°C., decomposed chemically. The breakdown products were not determined, but there is some indication that those resulting from heating or boiling are distinct from autoclaved breakdown compounds. Under the experimental conditions, none of the compounds having a maximum in the 520 to 560 millimicron range was evident. These include dehydrochlorinated p, p'-DDT and bis(parachlorophenyl)acetic acid (p,p'-DDA). Aerated and aged dispersions showed no chemical breakdown of DDT, but a physical change took place in that the DDT was more concentrated at the bottom and sides of the flask.

PORTMAN (R. W.). **Infestation of a Raccoon by *Amblyomma americanum*.**—*J. econ. Ent.* 40 no. 3 p. 450, 1 ref. Menasha, Wis., 1947.

A female of *Amblyomma americanum*, L., embedded in the connective tissue [cf. *R.A.E.*, B 34 165], was found near the ear on the pelt of a racoon trapped in Missouri in 1946.

HIXSON (E.) & MUMA (M. H.). **Hog Mange Control Tests.**—*J. econ. Ent.* 40 no. 3 p. 451, 1 fig., 5 refs. Menasha, Wis., 1947.

In tests in Nebraska on the control of *Sarcoptes scabiei suis*, Gerl., various sprays were applied to herds of pigs in small pens or sheds at a pressure of 200-225 lb. and a rate of about 3 U.S. quarts per animal. Sprays containing a benzene-hexachloride wettable powder used at 0.082 per cent.  $\gamma$  isomer gave no control but at 0.25-0.5 per cent. gave complete kill in one application. There were initial lesions of mange on 3rd December in a herd sprayed on 27th September, found free of mange on 17th October and allowed to associate with six unsprayed infested animals from 25th October. Mites were present on examination of herds that had received sprays containing 0.5 per cent. benzyl benzoate in emulsion, 0.5 per cent. DDT in emulsified solution or a proprietary rotenone spray. The results obtained with benzene hexachloride are considered very promising.

SWEETMAN (H. L.). **New Organic Insecticides to control Hog Lice.**—*J. econ. Ent.* **40** no. 3 pp. 454–455. Menasha, Wis., 1947.

In tests begun in 1946 with a view to eradicating a long-standing infestation of *Haematopinus suis*, L. (*adventicius*, Neum.) on pigs at Massachusetts State College, sprays containing 0.2 per cent. active ingredient were prepared from 25 per cent. emulsion concentrates of DDT and DDD [dichlordiphenyldichlorethane] and a 20 per cent. concentrate of chlordane. An emulsifier was used with the chlordane. In the early trials, the pigs were kept in pens, but later they were sprayed while being fed. A pig that had been freed of lice by the DDD spray and kept in isolation for about three weeks, was still uninfested one month after it had returned to an infested herd. During this period, the herd had access to a concrete wallow. In the next test, three pairs of pigs were treated with the various insecticides, and all appeared free of lice about two hours later and remained so during three weeks' isolation. Treatment of six brood sows with the insecticides 7–10 days before farrowing apparently effected complete eradication as no lice were subsequently observed on them or their young. Some 50 pigs were treated with the three materials in November, and no lice were seen on them during the next three months.

Newly hatched lice were observed about two weeks after a herd of about 12 pigs had been sprayed with 0.2 per cent. DDT in late October. A second application a few days later apparently eradicated the infestation, as no lice were observed during the next three months.

ROBERTS (B.). **New Zealand Department of Agriculture. Annual Report for Year 1945–46.**—78 pp. Wellington, N.Z., 1946.

It is stated in the course of this report (p. 35) that in preliminary dipping experiments in New Zealand, DDT (1 : 2,000), 666 [benzene hexachloride] (1 : 16,000) and derris containing 5 per cent. rotenone (1 : 2,000) gave comparable results against keds [*Melophagus ovinus*, L.] on sheep. All were effective and superior to a solution of sodium arsenite containing 0.2 per cent. arsenic, though none gave complete eradication. DDT (1 : 2,000) and 666 (1 : 8,000) were both highly effective against biting lice [Mallophaga] on sheep, but again could not be relied on to eradicate infestations completely.

MACLEOD (J.). **The protective Effect of Arsenic and Derris Dips against the Sheep Tick, *Ixodes ricinus* L.**—*Ann. appl. Biol.* **34** no. 2 pp. 207–223, 7 figs., 14 refs. London, 1947.

Observations in 1933 having led the author to believe that the effect of arsenical dips against *Ixodes ricinus*, L., on sheep might be more lasting than was generally supposed, he carried out laboratory and field studies in 1933–38, as a result of which a protective dip containing arsenic, derris, cresols and wool grease that subsequently came into common use [*R.A.E.*, B **34** 183] was developed. In view of present interest in the new synthetic chemicals as possible constituents of anti-tick dips [*cf.* **35** 104], it was considered desirable to publish an account of this experimental work on which the development of the original protective dip was based. The methods used in the field studies, which were made in Scotland, are described, and the interpretation of the results is discussed.

Sodium arsenite at bath strengths of 0.16 and 0.2 per cent.  $As_2O_3$  and disodium thioarsenate at 0.2 per cent.  $As_2O_3$  had effective durations (periods during which they maintained adult infestation at less than 50 per cent. of that on the control) of about a fortnight. Coal-tar creosote dips had little or

no value against reinfestation, but usually killed attached ticks rapidly. Used with arsenic, tar products also assisted penetration through the fleece. Dipping sheep fortnightly in mixtures of sodium arsenite and cresols showed no increase in protective value through cumulative effect of the arsenic. Laboratory and field tests with derris preparations [cf. 21 74] are described at some length. The laboratory tests showed that onset of effect was slower at lower concentrations and that unfed larvae were highly susceptible, and indicated that intoxication occurs during actual immersion. In the field tests, derris was equally effective whether used as an extract or as ground root. It killed all attached ticks at dilutions (expressed as extract) down to the order of 1 : 15,000 and a high proportion even at 1 : 80,000. It gave considerable protection for ten days at 1 : 5,000, after which the effectiveness rapidly disappeared. Its maximum effective duration, when applied to areas exposed to light, appeared to be 14-17 days. Its action on unfed ticks was very rapid [cf. 34 184]. Fouling a derris dip by passing sheep through it and adding sheep faeces or letting the dip stand did not reduce its effectiveness a week later. The duration of immersion was found to be important for both arsenical and derris dips, but particularly for the latter. To obtain full effect with derris washes, sheep must be immersed for at least half a minute [cf. 28 53].

The addition of wool grease enhanced the effective duration of arsenic but not of derris. This suggests that cessation of protection results not from loss of derris but from chemical change. In the final dip, the cresols exercised rapid action against the ticks attached at the time of dipping, the derris killed most of the ticks coming to the animals in the first 7-10 days after dipping before they could attach, and after this the arsenic killed many of the ticks that attached for the remainder of the protection period, which, with the action of the wool grease, was extended to about three weeks from dipping.

**THEILER (G.). Ticks in the South African Zoological Survey Collection. Part VI. Little known African Rhipicephalids.**—*Onderstepoort J. vet. Sci.* 21 no. 2 pp. 253-300, 53 figs., refs. Pretoria, 1947.

This paper, which is one of a series [cf. *R.A.E.*, B 35 35], contains descriptions of 21 African species of *Rhipicephalus*, showing their hosts and distribution, and a list of other African members of the genus. Of the species described, those recorded from domestic animals are *R. distinctus*, Bedford, from sheep, *R. kochi*, Dön., and *R. ziemanni*, Neum., from cattle, *R. supertritus*, Neum., and *R. tricuspis*, Dön., from horses, and *R. follis*, Dön., probably from domestic stock.

**KASCHULA (V. R.) & STEPHAN (S. A. R.). Mites, hitherto unrecorded in South Africa, collected in Natal from Fowls, Pigeons, Turkeys, Guinea-fowls, wild Birds and Rabbits.**—*Onderstepoort J. vet. Sci.* 22 no. 1 pp. 51-59, 16 pls., 8 refs. Pretoria, 1947.

The following is taken from the authors' summary and conclusions. All but one of the 17 species of mites here recorded from birds and rabbits are apparently recorded from South Africa for the first time. *Syringophilus bipectinatus*, Heller, and *S. columbae*, Hirst (taken on domestic fowl and domestic pigeon, respectively), produce marked distortion and malnutrition of the feathers, but the other mites do not apparently cause lesions, though it is possible that gross infestations may reduce vitality and lead to debility and anaemia.

GLASGOW (J. P.). **The seasonal Abundance of blood-sucking Flies in a grassed Woodland Area in central Tanganyika.**—*J. Anim. Ecol.* **15** no. 1 pp. 93–103, 2 figs., 9 refs. London, 1946.

Records are given of catches of *Hippobosca longipennis*, F., and Tabanids, made over a period of 30 months in 1940–42 in Mpwapa in the Kikombo Valley, Tanganyika. The valley is enclosed by steep hills from which several permanent streams descend. These disappear in the dry season soon after reaching the flat ground. All species were most numerous near the streams. *H. longipennis* is viviparous, and adults were present throughout the year. Tabanids have a flight season when adults are found and an off-season when they are not. From the lengths of the flight seasons, it appeared that six species had but one generation a year, one species probably two and the others (the species of *Tabanus* and *Haematopota*), which are present for most of the year, possibly several. Flight seasons of Tabanids in other parts of the world are reviewed from the literature. The apparent densities of the various species and of *Glossina pallidipes*, Aust., as monthly means for the four localities studied over the period of the survey are shown in an appendix.

The incidence of trypanosomiasis in cattle in the valley has fallen with a reduction in the numbers of *G. pallidipes*. The fact that mechanical transmission by other blood-sucking flies, the densities of which are shown to be high and sustained, does not appear to be considerable is thought strange, but it may be that the cattle are not herded close enough to game for mechanical transmission by flies from the latter to the former to be effected. The possibility of using other blood-sucking flies as indicators for *Glossina* spp. is considered, but, mainly on account of the influence of seasonal incidence and distance from a breeding place on catches of Tabanids, it is concluded that no indicator species will be found among these. *Hippobosca* spp. are also unsuitable, as they tend to be associated with particular hosts.

WATERHOUSE (D. F.). **The Effect of Colour on the Numbers of Houseflies resting on painted Surfaces.**—*Aust. J. sci. Res. (B)* **1** no. 1 pp. 65–75, 1 graph, 9 refs. Melbourne, 1948.

Details are given of experiments in which house-flies (*Musca domestica*, L.) were liberated in a white lacquered Peet-Grady testing chamber fitted with movable coloured corners and the numbers resting on these corners were recorded at intervals to provide adequate data for comparison. Full-gloss lacquer-finish paints were used, and the ascending order of preference for the particular colours tested was white and sky blue (equal); light grey; green; yellow and medium grey (equal); dusky blue; red [cf. *R.A.E.*, B **24** 61]. From measurements of the visual reflectances of the various colours it was found that the order of preference could be explained largely by a reaction to the intensity of the light reflected by the coloured surfaces, darker surfaces being preferred. It is pointed out, however, that this preference is unlikely to play more than an accessory part in controlling the movements of house-flies, since chemotropic stimuli exert a far more powerful influence.

KERR (R. W.). **The Effect of Starvation on the Susceptibility of Houseflies to Pyrethrum Sprays.**—*Aust. J. sci. Res. (B)* **1** no. 1 pp. 76–92, 5 figs., 3 refs. Melbourne, 1948.

Mortality of laboratory-reared adults of *Musca domestica*, L., subjected to sprays of 0.1 and 0.2 per cent. pyrethrins by the Peet-Grady method [cf. *R.A.E.*, B **37** 5] was higher among flies starved for periods of 1–6 hours immediately prior to exposure than among those given continuous access to

food before testing. Within this range of starvation time, mortality increased, but not uniformly, with starvation time. The cause of the relationship of mortality to starvation time was examined. Colorimetric determinations showed that the dosages of spray retained by individual flies after exposure varied with starvation time, and an analysis is given of the principal factors responsible. The amounts of spray acquired are much greater for flies in flight and increase with the speed of flight [*cf.* **34** 201 ; **36** 185], and it was found that the mean interval before knockdown decreased with increasing starvation time, the proportion of flies in flight at intervals of 2–11 minutes after spraying increased with it, and the speed of flight increased with starvation for up to two hours and then remained constant.

The methods commonly used for drawing samples of house-flies from a population for insecticidal tests by the Peet-Grady method are discussed, and attention is drawn to the possibility that starvation of the flies caused by the interruptions to their feeding routine during sampling and pre-test treatment may introduce unnecessary variations in susceptibility between samples. Deliberate pre-test starvation for determined periods is suggested as a method for increasing the susceptibility of flies of strains resistant to pyrethrum and so rendering them susceptible enough to the Official Test Insecticide for use in tests by the Peet-Grady method [*cf.* **37** 6].

**Spray Tests against Adult Mosquitoes.**—*Bull. Coun. sci. industr. Res. Aust.* no. 219, 40 pp., 2 pls., 3 figs., 13 refs. Melbourne, 1947.

Apart from the foreword and summaries, this bulletin comprises two papers, **Laboratory Spray Tests with Culicine** (*Culex fatigans*) **Adults**, by D. F. WATERHOUSE (pp. 9–27, 3 graphs, 10 refs.), and **Spray Tests with Anopheline** (*Anopheles punctulatus farauti*) **Adults**, by D. F. WATERHOUSE & D. O. ATHERTON (pp. 29–40, 2 pls., 3 refs.). These are abstracted below mainly from the authors' summaries.

In the first, an account is given of laboratory tests with *Culex fatigans*, Wied., carried out between July 1942 and July 1943 with a view to providing effective mosquito sprays for use by the forces in New Guinea and neighbouring islands. The standard Peet-Grady chamber and procedure were used [*cf.* *R.A.E.*, B **37** 5], except that the spray dosage was reduced from 12 to 2 ml. to approximate to conditions in practice and both knocked-down and active mosquitos were collected after the ten-minute exposure period to assess mortality. Kerosene was the base used for most of the sprays.

Concentration-mortality and concentration-knockdown curves for both sexes for sprays containing 0.01–0.14 per cent. w/v pyrethrins are given. For females, 0.01, 0.1 and 0.14 per cent. pyrethrins gave 79.2, 94.4 and 99.3 per cent. knockdown and 74.5, 97.5 and 99.3 per cent. mortality, respectively. Figures for ten-minute knockdown and 24-hour mortality were generally close. Mortality appeared to depend more on the amount of pyrethrins atomised than on the volume of spray used [*cf.* **34** 168]. Kerosene alone produced very low mortality, and the addition to it of creosote did not result in a satisfactory spray.

Undiluted oils of *Zieria smithii* or *Dacrydium franklinii* (Huon pine) or 50 per cent. oil of *Backhousia myrtifolia* in kerosene gave high mortalities, killing 81.5–92.1 per cent. of females. No increase in mortality was observed when either these oils or eucalyptus oils, sesame oil, or eudesmin, which is closely related to sesamin, were added to pyrethrin sprays.

A thiocyanate preparation (Lethane 384 special [**33** 22]) was not highly effective at concentrations of 5 or 10 per cent., although it gave a total kill of females at 15 per cent. Its addition to a pyrethrin spray did not increase the mortality. A spray containing 3.5 per cent. Thanite (bornyl thiocynoacetate

[cf. 36 166]) was more effective than a 0.1 per cent. pyrethrin spray, giving 98 per cent. knockdown and 99 per cent. kill of females, while 3 and 2.5 per cent. Thanite gave 95 and 93 per cent. mortality, respectively. The addition of 2.5 per cent. Thanite to a 0.01 per cent. pyrethrin spray reduced knockdown and kill. No additional mortality of females resulted when 5 per cent. D.H.S. activator (ethylene glycol ether of pinene) was added to 0.01 per cent. pyrethrins, although the knockdown was higher, nor did the addition of 0.34 per cent. N-isobutylundecyleneamide to a similar spray cause any significant increase in kill.

A spray containing 1 per cent. DDT gave only 55 per cent. knockdown but 94 per cent. kill of females, while 0.1 per cent. DDT gave 6.5 per cent. knockdown and 50 per cent. kill. The mortality percentages for 0.01 per cent. pyrethrins with and without 0.1 per cent. DDT were 80 and 64, respectively. Undiluted dimethyl phthalate gave 63 per cent. knockdown and 47 per cent. kill. A Freon aerosol bomb containing pyrethrins and sesame oil in dichlorodifluoromethane gave excellent results at the recommended dosage of four seconds spraying (which releases 0.0216 gm. pyrethrins) per 1,000 cu. ft.

Figures for differential mortality of males and females show that males were slightly more susceptible than females to all sprays except Thanite and the Lethane, to which they were equally and less susceptible, respectively. Tests of the susceptibility of different species showed that *C. fatigans* was more resistant than *Aedes aegypti*, L., *A. notoscriptus*, Skuse, or *A. alboannulatus*, Macq.

The main conclusions drawn from the tests were that a pyrethrin concentration greater than 0.1 per cent. would probably be necessary in the field and that none of the synergists or substitutes, except possibly Thanite, was likely to be of value. DDT was not available in quantity at the time.

The further tests described in the second paper were carried out in New Guinea in September 1943 with caged wild females of *Anopheles farauti*, Lav., in tents and in an airy native hut. Dosages of 1 fl. oz. per 2,100 cu. ft. and 1 fl. oz. per 3,000 cu. ft. were atomised, both by pressure sprayers and by hand spray gun, the two rates proving about equally effective. The effects of ten-minute and very short exposures to the sprays were recorded as percentage knockdown in ten minutes and percentage mortality after 18 hours. The carrier for the sprays, lighting kerosene, had no effect on the mosquitos under the conditions of the test. The lowest concentration of pyrethrins found to give both good knockdown and good kill (99.5 and 99 per cent., respectively) was 0.07 per cent. w/v. Data for two higher and three lower concentrations are given. A 0.5 per cent. DDT spray gave 97 per cent. kill but only 33 per cent. knockdown, while lower concentrations gave poor mortality also. The knockdown given by the 0.5 per cent. spray was rendered satisfactory by the addition of 0.03 per cent. w/v pyrethrins or 3.5 per cent. Thanite. A spray containing 0.25 per cent. DDT and 0.05 per cent. w/v pyrethrins also gave good results.

Less than 85 per cent. kill was given by sprays of undiluted dimethyl phthalate, 5 and 10 per cent. of a thiocyanate preparation (Lethane 384 standard [cf. 35 132]) and 3.5 and 5 per cent. Thanite. The comparative ineffectiveness of Thanite was attributed to the absence of conditions favouring a fumigant action. Dimethyl phthalate, dibutyl phthalate and Crystox (stated to be a product of the condensation of two molecules of isophorone) had no activating effect on pyrethrins under the conditions of test.

Little difference was noted between ten-minute and one-minute exposures to pyrethrins, DDT or a mixture of the two, but both knockdown and mortality were lower for the short exposure to Thanite. There was also little difference when pyrethrins, DDT or a mixture of the two were tested in a closed tent and an open native hut.

A comparison of the figures for knockdown in ten minutes and mortality in 1, 5 and 18 hours given by various sprays indicated that it was necessary to make an 18-hour count to obtain reliable information on effectiveness, particularly in the case of DDT. It was decided not to vary the spray of 0.14 per cent. pyrethrins provisionally recommended, and not to include a synergist.

WILKES (A.), BUCHER (G. E.), CAMERON (J. W. MacB.) & WEST jr. (A. S.). **Studies on the Housefly (*Musca domestica* L.). I. The Biology and large scale Production of Laboratory Populations.**—*Canad. J. Res.* (D) **26** no. 1 pp. 8–25, 2 refs. Ottawa, 1948.

BUCHER (G. E.), CAMERON (J. W. MacB.) & WILKES (A.). **II. The Effects of low Temperatures on laboratory-reared Puparia.**—*T.c.* pp. 26–56, 6 graphs, 23 refs. **III. The Effects of Age, Temperature, and Light on the Feeding of Adults.**—*T.c.* pp. 57–61, 1 graph, 6 refs.

The following are substantially the authors' abstracts of these three papers. When house-flies (*Musca domestica*, L.) were reared for tests of insecticides according to the Peet-Grady procedure with a mixture of about 15,000 cc. soft wheat bran, 7,500 cc. lucerne meal, 50 cc. malt extract, 94 gm. bakers' yeast cake and about 13,600 cc. water as the medium for the larvae, variations were observed that had considerable bearing on production and life of adults. Differences in length of life, fecundity, time of emergence from puparia, and onset of egg-laying occurred between different populations of flies. Investigations were carried out to determine the extent and causes of the variations and to develop more suitable techniques for producing large numbers on a more accurately predictable basis. Variability in production of puparia was found to be due largely to the age of female stock and rate of fermentation in the rearing medium through their effects on hatching and survival of larvae and excessive crowding caused by high temperatures. By using eggs from genetically-selected stock of known age and rearing in a medium of which the temperature was kept constant by water circulating through coils from a reservoir kept at 36°C. [96.8°F.], the production of flies was increased and maintained at a constantly uniform rate. A description is given of the equipment and methods used. When sawdust was substituted for all or part of the lucerne meal, the number and size of the adults obtained were reduced, but their reactions in experimental tests were the same as those of flies reared on the normal medium.

When puparia were exposed to different intensities of low temperature storage above 1°C. [33.8°F.], survival was decreased by lowering the temperature of storage and by increasing the duration of the storage period, or both. Mortality of adults following storage of puparia was influenced by the type of rearing container, crowding, age of puparia, humidity, concentration of gases in the pupal rearing chambers, and to some extent by changes in the food of the immature larvae, but not by the age or sex ratio of the parental stock, the size of puparia, selective breeding of resistant individuals or different strains of stock. Death did not occur in cold storage but during subsequent incubation at normal temperatures and at a definite stage in development near adult emergence. Temperatures below the threshold of development caused physiological disturbances that affected the oviposition and duration of life of the adults from pupae that survived, and the viability of their eggs. A proposed explanation is given of the lethal effects of low temperatures based on the inter-relationships of disturbances between the relative rates of development and differentiation of various ontogenetic systems.

For a short time immediately after emergence, adult house-flies do not consume food. They begin to feed at a temperature and age at which they first become active, males tend to feed before females, and feeding is to a

considerable extent dependent on the presence of light. There appears to be no upper age limit at which flies cease to feed. At 27°C. [80.6°F.], flies died in a very short time if they were not supplied with an abundance of liquid food. All died when starved for 24 hours at 27°C. after having once been fed.

**Peet-Grady Method. Official Method of the National Association of Insecticide and Disinfectant Manufacturers for evaluating liquid Household Insecticides.**

—*Soap & sanit. Chem.* Blue Book 1946 pp. 211–214. New York, N. Y., 1946.

This account of the Peet-Grady method of testing fly-sprays is essentially similar to one already noticed [*R.A.E.*, B 37 5], but a few minor modifications in the method are made. It is now stated that the test groups of flies [*Musca domestica*, L.] should have an average age of four days and contain individuals not less than three nor more than six days old and the rearing room should be kept at a temperature of  $82 \pm 2^\circ\text{F}$ . and a relative humidity of  $50 \pm 5$  per cent. The test chamber is also kept at  $82 \pm 2^\circ\text{F}$ . during tests.

The rearing medium now recommended is a mixture of 340 gm. of a standard dry preparation supplied by a commercial firm and 750 cc. of an aqueous suspension containing 15 gm. moist cake yeast and 10 cc. non-diatstatic Diamalt for each glass battery jar about 6 ins. in diameter and 9 ins. high. Eggs are collected for not longer than 16 hours from food dishes or other oviposition media in cages containing adult flies not more than eight days old and are washed in tap water at room temperature. About 2,000 are scattered in a pit in the medium in the jar and covered with loose medium, cloth covers are placed over the jars and these are set in the insectary at least 1.5 ins. apart. The maximum temperature in the jar about three days later must not exceed 130°F. Normally, all larvae have pupated by the seventh day after the eggs are put in the jars. The medium containing the puparia is air-dried at room temperature in a shallow tray, the puparia are separated from the medium by a blast of air and mixed and weighed in groups, and each group in a shallow dish is placed in a cage that provides at least 1 cu. in. of space per puparium. If the large-group procedure [*cf. loc. cit.*] is used, the group is a test unit consisting of about 500 puparia. For the small-group procedure, more than 500 puparia are placed in stock cages, and samples of 100 adult flies are taken for testing. A dish containing at least 15 cc. of a mixture of milk and water (1 : 1) for each 100 flies and so arranged as to prevent them from drowning is provided daily in each cage. Units are ready for testing on the second day of oviposition.

SIMMS (B. T.). **Report of the Chief of the Bureau of Animal Industry, Agricultural Research Administration, 19[45–]46.**—v+66 pp. Washington, D.C., U.S. Dep. Agric., 1946.

The campaign for eradicating *Boophilus annulatus*, Say, from the southern United States by dipping cattle, horses and mules was continued in the year ending 30th June 1946 [*cf. R.A.E.*, B 36 57]. Infestations in several counties of central Florida were found in and after December 1945, and a systematic eradication campaign was undertaken and the infested area placed under Federal quarantine. The quarantine was also maintained in part of Texas. Stray or smuggled animals from Mexico again brought ticks to the lower Rio Grande Valley of Texas, but spread to the unquarantined part of Texas was prevented. Porto Rico, where the tropical variety of the tick, *B. a. microplus*, Can., is prevalent and it was necessary to treat sheep and goats on infested premises, was requarantined. A test of the effectiveness of cubé powder

(4.4 per cent. rotenone), technical DDT and BHC (benzene hexachloride) containing 30 per cent.  $\gamma$  isomer in sprays against *B. annulatus* was made in Mexico in the spring of 1946. Nearly 40 heavily infested cattle were treated, and each received about 5 U.S. gals. liquid. All ticks were killed in 24 hours by 1 and 5 per cent. cubé powder in water, except the adult females, many of which were still alive after 14 days. Thereafter, nymphs and young adults were observed, indicating new infestations. Emulsions containing 1, 1.5 and 3 per cent. DDT killed most of the ticks in 24 hours, but a few females were alive 25 days after treatment. Thereafter, nymphs and adults were found. DDT with cubé powder gave satisfactory results in an emulsion containing 1-2.5 per cent. of each, but the mixture was no more effective than DDT alone. Emulsions containing 1 and 0.5 per cent. BHC killed all ticks, the former in 24 hours, the latter in rather more. One containing 0.25 per cent. failed to destroy some adult females. Reinfestation began after 14 days. When emulsions containing 1 per cent. each DDT and BHC were used, small ticks were killed in 2 hours and large ones were dead after 7 days. No living ticks were found 14 and 21 days after treatment. Thereafter the animals became reinfested. The soluble oils used as emulsifiers in the emulsions containing DDT and BHC caused slight to moderate blistering of the skin of some of the cattle, and the animals showed evidence of heat depression.

An emulsion containing 0.25 per cent. BHC (30 per cent.  $\gamma$  isomer) destroyed heavy infestations of *Otobius (Ornithodoros) megnini*, Dugès, in the ears of cattle in the Rio Grande Valley and prevented reinfestation for more than three weeks. The most satisfactory results were given by a mixture of 91 per cent. pure pine oil, 6 per cent. xylene and 3 per cent. BHC, one injection of which into the ears destroyed all larvae and nymphs in an hour and prevented reinfestation for 28 days. The cattle were only lightly infested after 41 days. Treatment with the standard mixture of pine tar and cottonseed oil [32 107] and with 0.25 per cent. DDT gave protection for only a few days.

Of five bulls sprayed once under high pressure with an emulsion containing 1 per cent. DDT, four were completely cured of psoroptic mange [caused by *Psoroptes bovis*, Gerl.], no mites or lesions being found on them after 36 days, whereas the fifth remained severely affected and continued to harbour living mites.

Many cattle treated with a wash containing cubé powder for the control of cattle grubs [*Hypoderma*] in Colorado in 1944-45 [36 57] were examined in the year under review, and the average reduction in infestation in two large herds in the centre of the test area was about 85 per cent. The reduction was less in herds near the border of the area, but the overall reduction was 70 per cent. During the year, 2,248 cattle in the area, the borders of which were somewhat modified, were treated with the same standard wash, about half for the first time and half for the second consecutive year.

Dipping in an emulsion containing 0.3 per cent. DDT eradicated infestations of the short-nosed sucking louse [*Haematopinus eurysternus*, Nitzsch] and the biting louse [*Damalinea bovis*, L.] on cattle and allowed only a light infestation of the long-nosed sucking louse [*Linognathus vituli*, L.] to persist. When eight cattle infested with both species of sucking lice were sprayed with an emulsion containing 0.25 per cent. BHC (30 per cent.  $\gamma$  isomer), they were found to be free of lice immediately after spraying and remained so for eight weeks.

The number of keds [*Melophagus ovinus*, L.] on sheep dipped in an emulsion containing 0.15 per cent. DDT in the previous year [36 57] had increased three months after treatment, but the flock as a whole was still only lightly infested. It was dipped again in a warm bath containing 0.2 per cent. DDT dissolved in xylene with a soluble commercial petroleum oil as emulsifier, and inspections after 51 and 170 days showed no living keds. Several heavily infested lambs were hand-dipped in an emulsion containing 0.2 per cent. BHC (20 per cent.

$\gamma$  isomer), and inspections after periods varying from five hours to 33 days failed to reveal any living keds. Young adults escaping from pupae on a tuft of wool from a dipped sheep soon died, presumably as a result of contact with the BHC adhering to the wool.

UNSWORTH (K.). **Studies on the clinical and parasitological Aspects of Canine Demodectic Mange.**—*J. comp. Path.* **56** no. 2 pp. 114–127, 20 refs. Croydon, 1946.

The following is substantially the author's summary. Observations at Liverpool on 51 cases of canine demodectic mange (caused by *Demodex canis*, Leydig) showed that in every instance the onset of symptoms occurred at some time during the first year of life [*cf. R.A.E., B 24 173*]. Of these 51 cases, 44 were of the uncomplicated, squamous type and the rest had become complicated as a result of bacterial invasion. Dogs with short hair accounted for 39 of the cases [*cf. loc. cit.*], while the remaining 12, including the seven complicated cases, occurred in long-haired ones. The lesions were confined to the head in 28 dogs. It was found that 10 per cent. of clinically normal dogs harboured the parasite without showing lesions and that the number of mites per unit weight of skin in these animals was very much smaller than in diseased animals of a comparable age. It is suggested that such "carrier" animals may be important sources of infection. *D. canis* was demonstrated in the lymphatic glands of both clinically normal and clinically diseased dogs [30 112], but never in the absence of a skin infestation. The evidence indicated that the glandular infestation was secondary to that of the skin and that the mites were carried passively to the glands. It is suggested that they do not reproduce in the glands and cannot subsequently regain the skin. While it was not possible to transmit follicular mange in a clinical form, the transmission of parasites to uninfected animals by direct skin transfer was not difficult. In general, such animals showed no symptoms of the disease, and it is suggested that lesions do not develop unless the presence of some special susceptibility allows the parasites to become invasive.

MACKIE (T. T.) & others. **Observations on Tsutsugamushi Disease (Scrub Typhus) in Assam and Burma. Preliminary Report.**—*Amer. J. Hyg.* **43** no. 3 pp. 195–218, 1 map, 3 graphs, 21 refs. Lancaster, Pa., 1946.

The following is partly based on the authors' summary of this report of investigations on tsutsugamushi disease among American and Chinese troops carried out chiefly in the vicinity of Ledo, Assam, and in the region about Myitkyina, Upper Burma, from December 1944 to November 1945. The disease was recognised to occur among these troops in Burma and Assam from late in 1943 onwards, and all available case records were studied to determine its incidence, the seasonal distribution of cases and the probable sites at which the infection was acquired. The approximate date of infection was estimated by assuming an incubation period of ten days. With few exceptions, the disease is not known to have occurred in American or Chinese troops in this theatre of war outside Burma or the Ledo area of Assam, but within these areas it appeared to be widely distributed. The numbers of cases per month from November 1943 to July 1945 and case rates per 1,000 per annum are shown in tables and graphs; peaks of incidence occurred in December 1943, May 1944, October 1944, January 1945 and June 1945, roughly corresponding (except for the January peak) to the beginning and end of the monsoon. These periods were also those in which *Trombicula deliensis*, Walch, was found in greatest abundance. The disease, however, was acquired in every month of the year, and a strict relationship between incidence rates and the type of military duty on which the units

concerned were engaged strongly suggested that a variety of factors participated in determining the epidemiology. A graph of case incidence in non-combatant troops showed no significant peaks.

The terrain of districts where outbreaks took place is described and discussed. There was no evidence that infection was consistently associated with a particular type of terrain, but its persistence about individual camp sites indicated that an area in which the disease had occurred remained hazardous for at least a year.

*Rickettsia orientalis* was recovered by inoculation into laboratory animals from over 50 lots of Trombiculid larvae obtained from rats or shrews (*Tupaia* and *Suncus*), trapped in their natural habitat. With one exception, *Trombicula deliensis* constituted 36–100 per cent. of the samples reserved for identification from lots giving successful isolation of rickettsiae. In no instance were the rickettsiae isolated from lots of mites in which *T. deliensis* was absent. This mite was shown to attach to man under field conditions. When laboratory-reared larvae, obtained in culture from adult females of *T. deliensis* taken in the field, were allowed to attach to and feed upon a laboratory animal, the animal died on the 20th day and *R. orientalis* was recovered from the peritoneal and pleural exudates, demonstrating that transovarial transmission occurs in this mite. A rough parallel found between the "established endemicity" based upon human case incidence and the recovery of mite and rodent strains of *R. orientalis* on the one hand, and the prevalence of *T. deliensis* on the other, suggested that the relative abundance of this mite in any area might provide an approximate index of the hazard of infection, and, since transovarial transmission was demonstrated in it, it was thought logical to regard it both as an important reservoir and as the vector.

**BUSHLAND (R. C.). Tests against Chiggers in New Guinea to develop a practical Field Method for impregnating Uniforms with Dimethyl Phthalate for Scrub Typhus Prevention.**—*Amer. J. Hyg.* 43 no. 3 pp. 219–229, 7 refs. Lancaster, Pa., 1946. **New Guinea Field Tests of Uniforms impregnated with Miticides to develop laundry-resistant Clothing Treatments for preventing Scrub Typhus.**—*T.c.* pp. 230–247, 2 refs.

The first of these papers contains an account of small-scale field tests made in the vicinity of Oro Bay, New Guinea, in February–June 1944 on the value of dimethyl phthalate as an acaricide and repellent for impregnating uniforms against Trombiculid mites [*cf. R.A.E.*, B 35 190, etc.]. The test species were *Trombicula buloloensis*, Gunther, and *Schöngastia pusilla*, Wom., which were abundant there and commonly attacked man [*cf. 34* 145]. Preliminary tests showed that stable emulsions of dimethyl phthalate could be made in 2 per cent. soap solution, and clothing and blankets were treated by immersing them in the emulsions, wringing out the excess liquid and drying them in the sun. On clothing, an emulsion of 5 per cent. dimethyl phthalate gave satisfactory protection for a period of five weeks of occasional wear or until it was laundered. The treated clothing withstood profuse sweating or wearing in the rain and was still toxic to mites after the wearer had waded for 15 minutes in fresh or salt water, but not after prolonged wading. The treatment withstood rinsing in cold water but not the usual methods of field laundering. When untreated shorts were worn, there were no ill effects from wearing impregnated clothing [*cf. 34* 170].

In the second paper, a detailed account is given of field tests carried out during March–August 1945 near Hollandia in Netherlands New Guinea, in which dimethyl and dibutyl phthalate, benzyl benzoate, diphenylamine and diphenylene oxide were compared for the same purpose [*cf. 35* 191]. All five materials were toxic to mites and, when applied to clothing at the rate of

2 oz. (in solution) per fatigue uniform, comprising jacket, trousers and socks, all protected the wearers from attack in an area heavily infested with *S. pusilla* and *S. blestowei*, Gunther. Dimethyl phthalate and diphenylene oxide failed to withstand a single cold-water laundering; diphenylamine withstood one and benzyl benzoate and dibutyl phthalate withstood two, but did not consistently protect after three or more launderings. Diphenylamine, however, was considered too irritating to the skin to be of practical use. Extensive comparisons were made of benzyl benzoate and dibutyl phthalate in solution or emulsion, at various rates and by different methods of application. Both compounds were effective when applied at the rate of 2.0-2.5 oz. per uniform, withstood drying at 210°F., and were more rapidly removed by laundering in hot water than in cold. Benzyl benzoate gave more nearly complete protection than dibutyl phthalate until the uniforms had been laundered three times. A mixture of equal parts benzyl benzoate and dibutyl phthalate appeared to be as effective as benzyl benzoate alone. The full results of the tests are given in tables.

YOUNG (M. D.), STUBBS (T. H.), ELLIS (J. M.), BURGESS (R. W.) & EYLES (D. E.). **Studies on imported Malarias. 4. The Infectivity of Malarias of foreign Origin to Anophelines of the southern United States.**—*Amer. J. Hyg.* **43** no. 3 pp. 326-341, 1 graph, 7 refs. Lancaster, Pa., 1946.

This fourth report of a series [*cf.* *R.A.E.*, B **36** 215], published before the third, contains a detailed account of laboratory experiments on the ability of the malaria Anophelines of the southern United States to transmit malaria of foreign origin. The observations covered a period of 18 months ending in June 1945. The following is based on the authors' summary. A total of 173 lots of *Anopheles quadrimaculatus*, Say, fed on soldiers with relapsing *Plasmodium vivax* infection. Of these infections, 117 originated in the South Pacific [*cf.* **36** 142], 40 in the Mediterranean area, 6 in the Caribbean area and the remainder in Liberia or Burma. Malarias from each of these areas infected *A. quadrimaculatus*; 61 per cent. of the cases infected mosquitos. The rate of infection in the total of 6,247 mosquitos dissected was 30.8 per cent. *A. quadrimaculatus* successfully transmitted these infections to man. When induced in patients undergoing malaria therapy, they were also infective to *A. quadrimaculatus*, and continued to be so through several serial transfers both by mosquito bites and by blood inoculations.

The average gametocyte count in the relapsing soldiers was 3.4 per 100 white blood cells. In general, an increase in gametocytes resulted in an increase in infection, with the sharpest increase occurring at one gametocyte per 100 white blood cells. Gametocytes were produced and mosquitos were infected as long as relapses occurred. The case with the most relapses (21) and the case with the longest duration of the disease (31 months) both infected mosquitos. Of the infected mosquito guts, 14 per cent. had over 100 oöcysts each. Of the infected glands, 29 per cent. showed over 1,000 sporozoites each. The average length of the sporogonous cycle of *P. vivax* in *A. quadrimaculatus* was 10.7 days at 74-80°F.; the shortest was 8 days, found in three cases from the Mediterranean and two from the South Pacific. Of 10 cases of infection with *P. vivax* in which antimalarial therapy had been begun, nine produced infections in *A. quadrimaculatus*. Under similar conditions, one case of *P. falciparum* failed to infect a mosquito.

Mosquitos kept at outdoor temperatures in Texas during April-May developed infections at about the same rate as those kept in the insectary. During April, the infections developed more slowly outdoors, the mean average temperature then being about 7°F. less than indoors. *A. quadrimaculatus* recently colonised

from nature and mosquitos of the same species from a long established colony showed similar rates of infection when fed simultaneously.

Abnormal sporozoites similar to those observed by Barber [24 290 ; cf. also 37 70] were found in the glands of some mosquitos that had transmitted malaria. The only factor consistently associated with their occurrence was a fungus infection that was prevalent in the mosquitos of the colony in the spring of 1945 and killed many of them.

*A. punctipennis*, Say, from South Carolina, and *A. pseudopunctipennis pseudopunctipennis*, Theo., and *A. albimanus*, Wied., from Texas, also became infected by the malaras of foreign origin. A theoretical numerical evaluation of relative susceptibility under the same conditions, when the most susceptible showed a 100 per cent. infectivity, would be: *A. punctipennis*, 100 ; *A. quadrimaculatus*, 98 ; *A. p. pseudopunctipennis*, 40 ; *A. albi nanus*, 2. Of the two cases of *P. falciparum* encountered, one infected *A. quadrimaculatus*.

MACKIE (T. T.). **Observations on Tsutsugamushi Disease (Scrub Typhus) in Assam and Burma. Preliminary Report.**—*Trans. R. Soc. trop. Med. Hyg.* 40 no. 1 pp. 15–46, 2 maps, 3 graphs, 39 refs. London, 1946.

Apart from a more extended review of the literature on tsutsugamushi disease, this paper is substantially the same as one of the same title already noticed [cf. *R.A.E.*, B 37 91]. In the course of the discussion that followed it, K. Mellanby stated (pp. 46–47) that practically unfed examples of *Trombicula deliensis*, Walch, taken on dead rodents in considerable numbers attached themselves to living rats under favourable conditions, which suggested that a badly executed campaign against rats might increase rather than decrease the danger of tsutsugamushi disease.

MAHAFFY (A. F.), SMITHBURN (K. C.) & HUGHES (T. P.). **The Distribution of Immunity to Yellow Fever in Central and East Africa.**—*Trans. R. Soc. trop. Med. Hyg.* 40 no. 1 pp. 57–82, 10 maps, 10 refs. London, 1946.

The following is almost entirely the authors' summary. The results are given of a yellow-fever protection test survey carried out in ten countries of Central and East Africa in 1937–43, as an extension of an earlier study [*R.A.E.*, B 24 296]. It involved the examination of 10,274 sera, and some of the findings have already been recorded [30 88, 97]. It was demonstrated that yellow fever had occurred recently in the Belgian Congo, Uganda, the Anglo-Egyptian Sudan, Eritrea, Somalia, Kenya and Northern Rhodesia. Abyssinia was not adequately studied, and Tanganyika Territory and Zanzibar were shown to have been free of recent infection. The disease had occurred within recent years as far east as the Red Sea coast of Eritrea and as far south as Balovale in Northern Rhodesia. The area within which immunity has been demonstrated should be regarded as the endemic zone in Africa. Its approximate boundary is indicated.

TURNER (J. G. S.) & WALTON (G. A.). **Report on Malaria in Freetown and District.**—*Med. Dep. Sierra Leone Pap.* no. 1, [1+]21 pp. Freetown, 1946.

The following is virtually the authors' summary of this record of observations relating to malaria in Freetown since 1900. A brief survey is given on the constitution and social habits of the population, and on the general physical conditions in the Freetown area. Conditions are ideal for the breeding of mosquitos and the transmission of malaria during five months in the year. For the other seven months, the Freetown streams and associated seepages

can maintain a moderate density of Anopheline mosquitos and malaria transmission is still possible [cf. *R.A.E.*, B 34 5-7]. The dominant vectors are *Anopheles gambiae*, Giles, and *A. melas*, Theo. Other Anophelines occur but are of minor importance.

From 1900 to 1941, progress in control was very gradual and the reduction in Anopheline density insufficient to cause any marked drop in malaria transmission. The change is estimated to be from 50 to approximately three infected bites per person per year. By 1944, the estimated annual number of infected bites per person had dropped to approximately one, and this corresponds to a mean parasite rate in the untreated child population of approximately 25 per cent. Sampling for malaria parasites has confirmed the estimated rate.

Data from previous observations on spleen and parasite rates show a steady fall in the incidence of malaria and indicate the relative safety of the central part of the town as compared with the suburbs and rural area. A brief note is given on the epidemiology of malaria caused by *Plasmodium falciparum* and *P. malariae* and on the acquisition of tolerance by the African. Attention is drawn to possible changes in this tolerance as the result of less frequent attacks and to the paramount necessity of continuing control measures.

The improvement in control measures is illustrated by reference to malaria rates in the Services and in the merchant seamen. During 1944 the combined use of mepacrine, of dress precautions, of pyrethrum sprays [cf. 34 90], of gauze-protected quarters, etc., reduced the risk of malaria in the army from a probable annual rate of 1,000 to 73 per 1,000 strength. In 1940, when quinine was still being issued and when other precautions were practically non-existent, the malaria rate in the army was reduced from a probable 6,000 per 1,000 to only 1,500. The importance of personal prophylaxis cannot be sufficiently emphasised.

In an appendix, the significance of the sporozoite rate in Anophelines is discussed in the light of information obtained in Freetown on *A. gambiae*.

YOFFE (J.) & FOX (D. G. R.). **The Behaviour and Feeding Habits of Anopheline Mosquitoes.**—*J. trop. Med. Hyg.* 49 no. 5 pp. 88-91, 3 figs. London, 1946.

In 1945, observations on Anophelines were made in two villages in Burma in the jungle to the east of Mandalay. The mosquitos were caught at intervals between 7 and 11 p.m. from cows in an open shed between 2nd and 17th November and from cows, the outside and inside walls of a hut ten yards away containing 3-4 persons and the surrounding vegetation between 25th November and 17th December. Nearly 9,500 Anophelines belonging to ten species were taken on the cows. They included 5,488 examples of *Anopheles aconitus*, Dön., 2,921 of *A. philippinensis*, Ludl., and only 12 of *A. minimus*, Theo. In the hut, 319 adults of five species were taken, including 202 of *A. minimus*, 68 of *A. aconitus* and 35 of *A. philippinensis*. Between 25th November and 17th December, 90 per cent. of the females of *A. minimus* caught were near man, while 83 and 87 per cent. of *A. aconitus* and *A. philippinensis*, respectively, were on animal bait. In further collections, the largest numbers of fed females of *A. minimus* were found inside inhabited huts, whereas the largest numbers of fed females of the other two species were on vegetation. The density of Anophelines was always lower on vegetation than on the walls of huts, and decreased progressively with increase in distance from the bait. Mosquitos usually settled on vegetation within 3 ft. of the ground but were occasionally found as high as 10 ft. Regular morning collections made from 1st to 14th December in three huts showed that *A. minimus* was the only Anopheline resting in them during the day in appreciable numbers.

If the small numbers of *A. aconitus* or *A. philippinensis* that bite man rather than cattle do so by chance and not by differential attraction, it is unlikely that the same female will bite man twice during its life. If this is correct, the finding of sporozoites in a few females of these species will not necessarily indicate that they are transmitting malaria.

MARKS (E. N.). **Studies of Queensland Mosquitoes. Part I. The *Aedes* (*Finlaya*) *kochi* Group with Descriptions of new Species from Queensland, Bougainville and Fiji.**—*Pap. Dep. Biol. Univ. Qd* 2 no. 5, [5 +]66 pp., 20 figs., 34 refs. Brisbane, 1947. **Part II. New Species of *Aedes* (Subgenus *Finlaya*).**—*T. c.* no. 6, [1 +]10 pp., 3 figs. **Part III. The *Aedes* (*Finlaya*) *australiensis* Group.**—*T. c.* no. 8, [1 +]42 pp., 17 figs., 7 refs. 1948.

These are the first three parts of a proposed series on the classification, systematic characters of the various stages and biology of the mosquitos of Queensland. The new species described comprise two from Queensland, a third from the Solomon Islands and a fourth from Fiji in the first part, one that is widely distributed in eastern Australia and New Guinea and another known only from one female from southern Queensland in the second, and two from Queensland in the third.

#### PAPERS NOTICED BY TITLE ONLY.

SMIT (F. G. A. M.). **Chronological Review of Dutch Authors and their Papers on Aphaniptera, with a List of Dutch Aphaniptera.**—*Tijdschr. Ent.* 88 pp. 375–388. Amsterdam, 1947.

DE ONG (E. R.). **Chemistry and Uses of Insecticides.**—9 $\frac{1}{4}$  × 6 ins., viii + 327 pp., 18 figs., many refs. New York, N.Y., Reinhold Publ. Corp., 1948. Price \$6. [See *R.A.E.*, A 37 142.]

BISHOPP (F. C.). **Present Position of DDT in the Control of Insects of Medical Importance** [review of the literature].—*Pests* 14 no. 8 pp. 14, 16, 18, 20, 22, 24, 28, 45 refs. Kansas City, Mo., 1946.

SOLOWAY (S. B.), SCHECHTER (M. S.) & JONES (H. A.). **Analysis of technical DDT. The chemical Evaluation of technical DDT by Dehydrochlorination.**—*Soap & sanit. Chem.* Blue Book 1946 pp. 215, 217–218, 221, 2 graphs, 16 refs. New York, N.Y., 1946.

BROWN (A. W. A.), ROBINSON (D. B. W.), HURTIG (H.) & WENNER (B. J.). **Toxicity of selected Organic Compounds to Insects. Part I. Tests for general Toxicity on Larvae of *Musca* [*domestica*, L.], *Tribolium*, and *Ephestia*, and Adults of *Sitophilus* [*Calandra granaria*, L.].**—*Canad. J. Res. (D)* 26 no. 3 pp. 177–187, 15 refs. Ottawa, 1948. [See *R.A.E.*, A 37 169.]

BROWN (A. W. A.), WENNER (B. J.) & PARK (F. E.). **Toxicity of selected Organic Compounds to Insects. Part II. Tests for contact Toxicity on Nymphs of *Blatella* [*Blattella germanica*, L.] and *Oncopeltus*, and Adults of *Tribolium*.**—*Canad. J. Res. (D)* 26 no. 3 pp. 188–196, 9 refs. Ottawa, 1948. [See *R.A.E.*, A 37 169.]

AITKEN (T. H. G.). **Studies on the Anopheline Complex of western America.**—*Univ. Calif. Publ. Ent.* **7** no. 11 pp. 273-364, 39 figs., 11 pp. refs. Berkeley, Calif., 1945.

The Anophelines recognised by the author in western North America are *Anopheles maculipennis occidentalis*, D. & K., *A. m. freeborni*, Aitken, *A. m. aztecus*, Hfm., *A. punctipennis*, Say, and *A. pseudopunctipennis franciscanus*, McCracken [cf. *R.A.E.*, B **30** 153-154]. Keys are given to the adults of both sexes and the eggs, larvae and pupae of these mosquitos, with the exception of the pupa of *A. m. aztecus*, which has not been described. *A. pseudopunctipennis* var. *boydi*, Vargas [cf. **28** 46; **29** 173] is distinguished from *A. p. franciscanus* in the keys to males and eggs, but the author classifies it as a variant of the latter. After general notes on the distribution of *A. maculipennis*, Mg., and the history of the species complex in North America, descriptions are given of all stages of *A. m. occidentalis* and *A. m. freeborni* and the adults, larva and egg of *A. m. aztecus*, their identity and morphology are discussed, and characters distinguishing each of them and *A. quadrimaculatus*, Say, and a variant of *A. m. freeborni* from New Mexico are tabulated. The morphology of members of the *maculipennis* complex in America and the Old World is also compared. The position of *A. m. lewisi*, Ludlow, in the complex is discussed separately, and lectotypes are designated for it; it is closely related to *A. m. messeae*, Flm., which may prove to be identical with it. The adults of *A. pseudopunctipennis* and *A. punctipennis* are also described, and the morphology of all stages is discussed, as well as the variation existing in different stages among the North and the Central and South American forms of *A. pseudopunctipennis*.

The distribution, bionomics and relation to malaria of the five forms are discussed. The most important vector in the western United States is stated on epidemiological evidence to be *A. m. freeborni* [cf. **33** 155], particularly in the irrigated regions of New Mexico, the San Joaquin and Sacramento Valleys in California and the Willamette Valley in Oregon [cf. **37** 8]. Brief comments on three new names for variants noted in American Anopheline complexes published by Vargas [**29** 172; **30** 154; **32** 78] after this paper was submitted for publication are made in an addendum.

HARMSTON (F. C.) & REES (D. M.). **Mosquito Records from Idaho.**—*Pan-Pacif. Ent.* **22** no. 4 pp. 148-156, 5 refs. San Francisco, Calif., 1946.

Collection records and notes on habitats and sometimes on prevalence and habits are given for some 30 species of mosquitos (including *Anopheles maculipennis freeborni*, Aitken, *A. maculipennis occidentalis*, D. & K., and *A. punctipennis*, Say) recorded from Idaho on the basis of collections and records in the literature.

KRUSÉ (C. W.) & METCALF (R. L.). **An Analysis of the Design and Performance of Airplane Exhaust Generators for the Production of DDT Aerosols for the Control of *Anopheles quadrimaculatus*.**—*Publ. Hlth Rep.* **61** no. 23 pp. 1171-1184, 5 figs., 8 refs. Washington, D.C., 1946.

In this paper, the authors give information on the design and performance of the aeroplane exhaust generator that was used to apply thermal aerosols containing DDT for the control of larvae of *Anopheles quadrimaculatus*, Say, in the impounded waters of the Tennessee Valley Authority [cf. *R.A.E.*, B **34** 99, 189] and a flow diagram for the equipment used. They show how to

calculate the cross-sectional area of the venturi throat required to produce an aerosol of any desired mass median particle diameter and how to minimise undesirable back pressures in the apparatus. The solvent used for the DDT should permit the use of concentrated solutions, to reduce the load, and possess low volatility, to decrease evaporation from the hot exhaust gases and increase the persistence of the solution on the water surface. The one selected, Velsicol NR-70, the specifications of which are given, was a mixture of at least 70 per cent. tri-, tetra- and pentamethylnaphthalenes, and the 20 per cent. solution of DDT used in it weighed 9.35 lb. per U.S. gal. In field tests of distribution, the aeroplane flew at a height of 20–30 ft. during the inversion conditions that obtain just after dawn. The width of the swathe obtained varies inversely with the particle size of the aerosol, and it was found desirable to use particles under 50 microns in diameter to obtain a satisfactory swathe width and uniform distribution. It was also found necessary to use particles of this size to obtain adequate penetration of heavy vegetation. The mass median particle diameter finally recommended for the impounded waters is 25–50 microns. An analysis of the swathe cross-section is given. Tests with an aerosol having a mass median diameter of 35 microns indicated that a deposit of 0.0001 lb. DDT per acre gave at least 90 per cent. kill of larvae in pans in the open, and from this it was calculated that deposits of 0.0005, 0.0025 and 0.005 lb. DDT per acre would be necessary under conditions of light, medium and heavy plant cover, respectively. From these figures, a table is given showing the effective swathe widths obtainable with various rates of application under different conditions of vegetative cover.

JOHNSON (H. A.) & EASON jr. (J. L.). **DDT in Paradichlorobenzene as a Larvicide.**—*Publ. Hlth Rep.* **61** no. 32 pp. 1185–1188, 1 graph. Washington, D.C., 1946.

During 1945, tests were made to determine whether DDT incorporated in paradichlorobenzene pellets and submerged in a stream would be lethal to larvae of *Anopheles* over a period of time. A slow-flowing stream 6–9 feet wide and free of vegetation was selected; the banks were overgrown with grass, which offered shelter for numerous Anopheline larvae. The water surface was often covered entirely or in part with organic scum, which shifted with the wind. A portion of this stream was divided into a number of connected test areas, 84 to 291 ft. in length. The pellets were prepared by melting the paradichlorobenzene in a beaker and adding both DDT in crystalline form and DDT in a solvent, and in some cases also an emulsifier. To ensure even distribution of the DDT, the hot paradichlorobenzene was stirred until the congealing point was reached. Wires were inserted for handling purposes; by means of these, each pellet was fastened in the water at the upper end of a test area, close to the bank. Details of each pellet are given in a table; they weighed 408–565 gm. and contained 475–575 cc. paradichlorobenzene, 20 gm. crystalline DDT, 25 or 50 cc. of a 7 per cent. solution of DDT or 25 cc. of a 50 per cent. one, and 0.12 cc. Triton X-100. They were deposited in late June and left until early October. The numbers of Anopheline larvae in the test areas and in an untreated control area upstream were compared by dipping at intervals; the average numbers per dip are shown. It was apparent from these that in spite of the unusual and frequent summer rains, a material reduction in larval population took place in the treated areas during the entire season. The quantity of DDT dispensed by the pellets was very small, as they disintegrated less than half their volume in 3½ months. It is concluded that by increasing the rate of disintegration, a higher degree of control might be obtained.

HATCHETT (S. P.). **Winter Survival of *Aedes aegypti* (L.) in Houston, Tex.**—*Publ. Hlth Rep.* 61 no. 34 pp. 1234–1244, 2 graphs, 11 refs. Washington, D.C., 1946.

An account is given of investigations carried out at Houston, Texas, in the winter of 1944–45 on the overwintering habits of *Aedes aegypti*, L.; the winter weather in this area is changeable, as there are usually several periods of frost and days when the mean temperature is over 70°F. [cf. *R.A.E.*, B 34 87]. They followed a preliminary study on the same lines carried out in the preceding winter but begun rather late, and were continued from mid-November until April, during which period some 10,000 eggs from laboratory-reared females were placed in various types of containers, under different environmental conditions. Some eggs were kept immersed, others were immersed only after rainfall, and others were allowed to incubate for about 72 hours and then kept dry; some of the containers were in partly protected situations, while others were fully exposed. All eggs not continually immersed were immersed in rain water on 3rd March, and hatching was observed until 3rd April. Since the winter of 1944–45 was exceptionally mild with frost on only one day, experiments were also made with artificial refrigeration. The following are the author's conclusions.

Over 40 per cent. of the eggs hatched that had been continuously wet all season. In contrast to this, during the 1943–44 season when winter conditions were more severe, approximately 25 per cent. of the continuously wet eggs hatched. During both seasons less than 30 per cent. of the eggs hatched that remained dry until winter conditions no longer existed and were then immersed. Approximately the same percentage applies to eggs intermittently dried between rains. Eggs stored in partially protected places, whether wet or dried, tended to produce somewhat larger hatches than those left in fully exposed situations.

Many eggs hatched when the mean temperature was 70°F. or over. However, there were some eggs hatching throughout the entire winter, although very few hatched when the mean temperature was below 50°F. In the 1943–44 season, no eggs hatched when the mean temperature fell below 45°F. A few eggs hatched approximately 48 hours after they were placed outdoors. These eggs were probably over 18 hours old when removed from the indoor cage where they were deposited. On the other hand, some eggs did not hatch until 90 to 95 days of immersion had elapsed. The mean period of immersion before hatching was about 32 days.

Eggs that had been continuously wet since time of deposition did not survive artificial cold of 26°F. when it lasted 24 hours or longer. However, 10 per cent. of the eggs hatched that previously had been dry and were then immersed in cold water and frozen at this temperature for 24 hours. Approximately half of all eggs hatched that were previously exposed to artificial cold of 34°F. for 24 hours.

During both winters, larvae were better able to survive cold weather when there was a layer of organic matter on the bottom of the container. Larvae that have just emerged from eggs, and old larvae preparing to pupate, are more susceptible to sudden chilling than others. During the entire season approximately half of the larvae under observation became adults. But previous to February 15th, less than 20 per cent. of them became adults. The period from hatching to emergence of adults ranged from 7 to 59 days. Most specimens took 2 to 3 weeks to complete their development and emerge as adults. The death rate of slowly maturing larvae was high. Most adults whose immature development was slow were weak, and many died within 2 to 3 days after emergence.

The mean pupal period during this winter was 4 days. No individual lived that remained as a pupa for more than 10 days. Most females that emerged

after the middle of February lived at least long enough to mate, feed on blood, and oviposit.

The size of the container had little if any influence on the survival of eggs, larvae, or pupae. In view of the above data, it would appear that for control during mild winters, special emphasis should be placed on the elimination of all small receptacles, since many would possibly have viable eggs adhering to their inner surfaces, and some of these eggs may remain dry or even wet for long periods and still hatch and develop into adults.

KIDO (G. S.) & ALLEN (T. C.). **Colloidal DDT. Its Use in Insecticide Sprays.**—*Agric. Chem.* **2** no. 6 pp. 21–23, 67, 69, 3 graphs, 3 refs. Baltimore, Md., 1947.

In an attempt to eliminate the undesirable features of DDT sprays made from wettable powders, emulsifiable oil preparations and solutions in kerosene, liquid concentrates were prepared consisting of finely divided DDT particles, most of them approximately one micron in size, but some 30 microns long and 2–3 microns wide, suspended in water; flocculation was prevented by means of a dispersing agent. Such concentrates are described as colloidal dispersions of DDT [*cf.* *R.A.E.*, B **36** 11], and consist of DDT, an emulsifying agent and water, with or without the addition of a suitable DDT solvent. Those containing a solvent had the better physical properties and were tested for insecticidal value [*cf.* also A **37** 182]; they consist of 40 per cent. colloidal DDT; 20 per cent. of a mixture of a saturated hydrocarbon petroleum distillate and alkylated aromatic hydrocarbons; 3–6 per cent. non-ionic emulsifying agent, such as an aromatic hydrocarbon with a polyethylene oxide side chain (*e.g.* a polyglycol ether alcohol); and 34–37 per cent. water. They are of a creamy semi-solid consistency, pour readily and do not cake. They are stable under ordinary storage conditions and retain their physical characteristics at temperatures as high as 70°C. [158°F.]. Freezing or storage at 4°C. [39.2°F.] for ten months solidifies them, but does not alter their properties when thawed. The settling rate of the diluted concentrate is slow compared with those of DDT wettable powders, and since only a small quantity of oil is present in the dispersion, all the DDT exists in a solid phase.

A laboratory test of the effectiveness of the deposits from four DDT sprays, made from a colloidal dispersion, emulsifiable solution, micronised wettable powder and pulverised wettable powder, in which house-flies [*Musca domestica*, L.] were the test insect, showed that the first three were equally effective at concentrations of 1 and 2 lb. DDT per 100 U.S. gals. water, but that colloidal DDT was less effective than the other two at 0.25 lb. per 100 U.S. gals. The pulverised wettable powder gave the slowest knockdown under the conditions of the experiment. The deposit from a spray of 1 lb. colloidal DDT per 100 U.S. gals. water lost most of its toxicity after exposure to ultra-violet light for 48 hours, whereas the deposits from the other sprays were moderately toxic after such exposure.

Preliminary studies with colloidal DDT on limed surfaces such as occur in dairy barns indicated that it has suitable physical properties for fly control. Unlike wettable powders, it can be applied at a strength of 5 per cent. without clogging spray nozzles, since the particles are relatively small. The inner surfaces of petri dishes were brushed over five times with a mixture prepared from casein glue and hydrated lime, and the dry coating was sprayed with DDT and kept at room temperature for a week; five-day old flies were then put in the dishes, which were covered with glass plates. Comparison of the times taken by the deposits to give 50 per cent. knockdown showed that colloidal DDT was less effective than DDT wettable powder, which lost little of its toxicity at the lowest concentration, but as effective as DDT in emulsified

solution at concentrations of 5 and 2.5 per cent. and more so at 1.25 and 0.625 per cent. Lime does not react chemically with DDT at room temperatures, and the variation in toxicity shows a correlation with the physical nature of the spray deposits. When solutions or emulsions are sprayed on absorptive lime surfaces, some of the DDT appears to be carried into the lime with the liquid carrier, whereas most of the relatively large particles of DDT in the wettable powder remain on the surface; colloidal DDT, being intermediate in size, shows intermediate toxicity on such surfaces.

SCHROEDER (H. O.) & LINDQUIST (A. W.). **Sprayers for dispensing concentrated Insecticides.**—*Soap & sanit. Chem.* **22** no. 6 pp. 149–151, 173, 3 figs., 3 refs. New York, N.Y., 1946.

Details are given of the construction and operation of a pocket-size spray atomiser that has been found suitable for the dispersion of concentrated household fly-sprays [*cf. R.A.E.*, B **34** 168].

FALES (J. H.), MCGOVAN (E. R.) & GOODHUE (L. D.). **Aerosol Toxicity. Effect of the nonvolatile Content of a DDT Aerosol on Mortality of House-flies.**—*Soap & sanit. Chem.* **22** no. 6 pp. 157–158, 2 graphs, 2 refs. New York, N.Y., 1946.

The following is based on the authors' summary of further experiments on the influence of the proportion of non-volatile material in an aerosol solution on toxicity [*cf. R.A.E.*, B **32** 99; **35** 127]. Two series of tests in a Peet-Grady chamber showed that an aerosol released by dichlorodifluoromethane containing 7.5, 10, 15, 20 or 30 per cent. by weight of a solution of DDT in dibutyl phthalate (1:14), the latter material chosen because it is non-volatile and is a good solvent for DDT, gave the greatest mortality of house-flies (*Musca domestica*, L.) when the non-volatile content of the solution was about 15 per cent. The particle-size distribution curves are presented for solutions containing 10, 15, 20 and 30 per cent. of non-volatile material. The most toxic aerosol had 50 per cent. of its volume in drops below three microns in radius and the remainder in drops of 3–20 microns radius. Aerosols that were finer and coarser than this were less toxic.

**Testing of Roach Sprays.**—*Soap & sanit. Chem.* **22** no. 7 pp. 145, 147, 148E, 148G, 6 refs. New York, N.Y., 1946.

Full details are given of a tentative method developed by the National Association of Insecticide and Disinfectant Manufacturers for testing sprays against cockroaches. It is based on those of Hazard and Bottimer [*R.A.E.*, B **36** 186]; the insects are not chilled prior to use. The test insects are to be laboratory-bred adult males of *Blattella germanica*, L., that have emerged at least three days previously, or, if the age of the culture is not known, that have acquired their dark pigmentation. They should be reared under uniform conditions at 75–85°F. and 30–50 per cent. relative humidity, and any suitable method of rearing may be used; that of Woodbury & Barnhart [**28** 54, etc.] has given good results. For a test, ten uniform groups of 20 cockroaches each shall be used for each insecticide (including the Official Test Insecticide), and the dosage shall be such that the O.T.I. will give 70–90 per cent. dead and moribund in 48 hours (usually 0.5–0.9 ml.). The size of the testing chamber is to be 18×18×25–30 ins. If results at intervals greater than 48 hours are desired, the cockroaches should be given food and water at the end of that period.

HAZEN (A. C.) & GOODHUE (L. D.). **Insecticidal Aerosols. Stability in Storage studied by accelerated Aging Tests.**—*Soap & sanit. Chem.* **22** no. 8 pp. 151, 153, 155, 6 refs. New York, N.Y., 1946.

The results are given of further accelerated ageing tests to determine the effect of adding various stabilisers or inhibitors to aerosol solutions to prevent their alteration in storage [*cf. R.A.E.*, B **35** 196]. Various metals such as tinned iron, aluminium, stainless steel and iron alone and copper and iron together were used in the tests.

For the rapid evaluation of stabilisers, an agricultural aerosol solution containing DDT, cyclohexanone, Velsicol, acetone and methyl chloride (5 : 5 : 5 : 35 : 50) was used as an indicator. The acetone contained some moisture, which, in the presence of methyl chloride and DDT, causes failure within 2–3 days under the conditions of the test. The results showed that 0.25 per cent. propylene oxide had some stabilising effect and 1 per cent. prevented failure for 43 days, after which the test was discontinued. Other epoxy compounds, such as 3, 4-epoxy-1-butene, alkyl glycidyl ether, ethyl butyl glycidyl ether, phenyl glycidyl ether and diglycidyl ether, were also good stabilisers. All these compounds are somewhat toxic to animals, but are unlikely to be dangerous in such small amounts. Sodium carbonate on filter paper stabilised the agricultural formula for 24 days, but in an aerosol solution containing 20 per cent. pyrethrum extract, DDT, pentane, deodorised kerosene and Freon-12 (dichlorodifluoromethane) (4 : 1 : 15 : 8 : 72), which remained unchanged for 150 days without a stabiliser in the presence of tin, it caused polymerisation of the pyrethrum; sodium bicarbonate also caused polymerisation of the pyrethrum, but not so readily. The fact that sodium carbonate acts as a stabiliser indicates that elimination of free hydrochloric acid is the important requirement [*cf. loc. cit.*].

Propylene oxide and other epoxy compounds were also effective when copper and iron strips were used together in an aerosol solution of pyrethrum extract, DDT, APS-202 (an aromatic petroleum solvent) and Freon-12 (2 : 3 : 12 : 83), a combination that ordinarily fails quickly. Dicyclohexylamine, pyridine, ethylaniline and N-mono-n-butylaniline were not good because precipitates and tar were formed and colour formation occurred. Tests of four of the DDT solutions with no metal strips showed that changes take place that are not due to the metal. Two low-pressure aerosol solutions, containing pyrethrum extract, DDT, xylene and Freon-142 (chlorodifluoroethane) (3 : 2 : 8 : 87) and Pyrenone 100 (a mixture of pyrethrum extract and piperonyl cyclohexenone), DDT, xylene and Freon-142 (5 : 2 : 6 : 87), remained unchanged for 27 days in the presence of iron. A solution of pyrethrum extract,  $\gamma$  benzene hexachloride, APS-202 and Freon-12 (3 : 2 : 10 : 85) kept for 58 days without a stabiliser.

It is concluded that failures apparently result from conditions caused by the liberation of hydrochloric acid. This can be controlled by the addition of propylene oxide, and since 0.25 per cent. of this compound has some stabilising effect on the agricultural aerosol solution, it can be assumed that a formula that will last for 90 days without a stabiliser would last almost indefinitely with 0.5 per cent. propylene oxide.

MCGOVAN (E. R.) & PIQUETT (P. G.). **Roach Powder Tests. A Comparison of the Toxicity to Roaches of four common Ingredients of Roach Powders : Sodium Fluoride, Pyrethrum, DDT and the Gamma Isomer of Benzene Hexachloride.**—*Soap & sanit. Chem.* **22** no. 8 pp. 157, 159, 181, 1 ref. New York, N.Y., 1946.

The authors describe a comparative test of dusts against laboratory-reared adult females of *Periplaneta americana*, L., and *Blattella germanica*, L. A commercial dust containing 95 per cent. sodium fluoride was used undiluted; the

other powders were prepared by mixing an acetone solution of technical DDT (75 per cent. p, p' isomer),  $\gamma$  BHC (the  $\gamma$  isomer of benzene hexachloride) or a pyrethrum concentrate with fuller's earth and evaporating the solvent. They contained 1 per cent. DDT, 2 per cent.  $\gamma$  BHC or 0.6 per cent. pyrethrins. The desired amount of insecticidal powder was spread over the centre of a nine-inch crystallising dish, the treated area covered with an inverted dish and the test insects released in the clean surrounding area at 70°F. and 70 per cent. relative humidity. They were provided with food and water and allowed to settle down before the cover was gently removed from the insecticide. They were then free to enter the treated area at will. As a result of preliminary tests, the maximum and minimum amounts of powder per dish were fixed at 60 and 5 mg. and the number of insects at 15 of *Periplaneta* or 60 of *Blattella*. Mortality and knockdown counts were made at intervals from one hour after the beginning of treatment to four days for *Blattella* and ten for *Periplaneta*. Average results based on three tests are given in a table. Pyrethrum caused the highest knockdown of both species in one hour,  $\gamma$  BHC caused medium knockdown and sodium fluoride practically none, while DDT gave slight knockdown of *Blattella* and practically none of *Periplaneta*. After one day, the figures were improved for all materials except pyrethrum, for which they were somewhat lower, owing to partial recovery from knockdown, and at the final counts, all materials at suitable rates gave over 70 per cent. mortality of both species, except DDT, which was less effective against *Periplaneta*. It is calculated from the results that the amounts of toxicant required to give 70 per cent. mortality of *Periplaneta* in ten days and (in brackets) of *Blattella* in four under the conditions of the test, expressed as micrograms of toxicant applied per gm. weight of cockroaches exposed, would be 69 (31) for  $\gamma$  BHC, 36 (217) for DDT, 10.4 (43) for pyrethrins and 1,763 (1,375) for sodium fluoride.

TELFORD (H. S.) & GUTHRIE (J. E.). **Toxicity of DDT Sprays to Livestock.**—*Soap & sanit. Chem.* **22** no. 9 pp. 124–125, 133, 1 fig. New York, N.Y., 1946.

Studies on the effect on dairy cows and goats of DDT applied in sprays as emulsified solutions were undertaken in view of the widespread use that is likely to be made of it in sprays, dips and dusts for livestock. Weekly haemoglobin determinations and white and red cell counts on two cows, one of which was sprayed 11 times per week for 12 weeks with 100 cc. of an emulsion containing 10 per cent. DDT and the other with a similar emulsion without DDT, indicated no seriously detrimental effects on either animal. The cow that received the DDT had a higher leucocyte count during and after the last week of the experimental period, but it is questionable whether it was attributable to the DDT. A differential examination of stained smears indicated no significant shift in the blood picture. Except for a slight fall in both cows during the first week of spraying, the milk yields appeared normal. No skin irritation or signs of poisoning were observed. The cows gave birth to normal young, 3½ and 7 months after spraying ended.

Excessive quantities of emulsions containing DDT were applied to two goats to determine whether enough DDT could be absorbed through the skin to produce toxic symptoms. Goats were chosen as they do not lick themselves. A third goat received the emulsion without DDT. One of the test goats, which was receiving 150 cc. spray containing 5 per cent. DDT 11 times a week, developed a pregnancy disease during the 12th week, and two kids were delivered by caesarean section. Both soon died after exhibiting tremors and convulsions suggestive of DDT poisoning. The goat died the following morning, having shown no symptoms of DDT poisoning. At necropsy, it showed various macroscopic pathological changes, the relation of which to the DDT was not

clear. The other test goat, which received 50 cc. spray containing 5 per cent. DDT 11 times a week for 12 weeks followed by 75 cc. of 10 per cent. spray six times a week for five weeks, and the control goat, which received the same applications of spray without DDT, showed no such changes. All the animals gained weight and showed no symptoms of poisoning. Another goat was then sprayed with 150 cc. emulsion containing 10 per cent. DDT eleven times a week for three weeks. At the end of this time, it gave birth to two kids, both of which died within 48 hours, exhibiting tremors and convulsions. Spraying was continued for a further six weeks, during which the goat suckled another kid. Both goat and kid remained apparently normal except that the goat lost a considerable amount of hair. The blood of the goat seemed normal except for a lower haemoglobin content following parturition. It thus appears that the kids that died were not poisoned by the milk of the mother and there is a suggestion that excessive amounts of DDT applied in emulsion as sprays over extended periods may have some detrimental effect on the foetus. However, the possibility of the solvents being responsible was not eliminated, as the control animal was not pregnant.

McGOVRAN (E. R.) & FALES (J. H.). **Toxicity of Aerosols. Rate of Movement through and Height of Suspension in a toxic Aerosol influences Mortality of caged House Flies.**—*Soap & sanit. Chem.* **22** no. 9 pp. 127–129, 3 graphs, 3 refs. New York, N.Y., 1946.

In tests with liquefied-gas aerosols for the control of insects in large halls it was noticed that their toxicity was greater than that indicated by small-scale tests. This was attributed to movement of the aerosol-laden air, and numerous experiments with house-flies (*Musca domestica*, L.) were carried out to obtain data on the effect of movement on the toxicity of aerosols, by comparing the effectiveness of a pyrethrum aerosol against free-flying individuals with its effectiveness against flies in cages moved at various speeds. The results of the final series of tests are given in this paper and discussed.

The experiments were carried out in a 216 cu. ft. Peet-Grady chamber, the aerosol being discharged horizontally from a point 6 ins. below the top and so directed that the mist at the time of discharge did not envelop the cages in which the flies were confined. These were cylinders of 16-mesh wire screen, and they were attached to a rotating arm that moved in a horizontal plane and was put in motion as soon as the aerosol had been discharged. The insects were moved at speeds of 1.25, 2.5, 5, 10 and 20 miles per hour. Free-flying house-flies were released in the chamber when there were no moving cages present, as these would have created air currents and also stimulated the insects to abnormal activity. In an experiment to determine the effect of exposure at various levels in the test chamber, stationary cages were placed at three different heights.

The following is from the authors' summary of the results. Confining the flies in moving cages reduced the mortality at low dosages and slow speeds but increased it at high dosages and high speeds in comparison with the kill of free-flying flies. The slope of the dosage-mortality curve was much steeper for the caged insects. In the range tested, quadrupling the dosage increased the kill of flies by an average of 36 per cent. for those in moving cages and 3 per cent. for free-flying insects. The level at which stationary cages were hung had a marked effect on mortality. A dosage that killed 94 per cent. of free-flying flies killed 98, 83, and 16 per cent. of flies caged at low, middle and high levels. The dosage-mortality curves were steeper for flies in stationary cages than for free-flying flies. These effects in the stationary cages are attributed to the settling of the droplets of insecticide; it is suggested that different sizes of

aerosol droplets would cause different mortalities of insects confined at the same level.

PEARSALL (D. E.) & WALLACE (P. P.). **Insecticidal Cords. A convenient Method of generating insecticidal Smoke by burning Cords impregnated with DDT or other toxic Materials.**—*Soap & sanit. Chem.* **22** no. 10 pp. 139, 141, 143, 161, 163. New York, N.Y., 1946.

The authors describe a method for applying DDT and other insecticides that can readily be volatilised by heat, by impregnating a combustible cord with them and vaporising them by the controlled heat produced when the cord is burnt. Rotenone, pyrethrum, nicotine and DDT have been employed successfully, but DDT appeared so promising that cord containing it has been used almost exclusively during the period of testing. The proprietary name Cordacide has been given to the product.

On ignition, the cord burns rapidly, and the DDT is dispersed in the air as a voluminous whitish vapour composed of extremely minute particles, in which form it is very efficient in killing insects that are susceptible to DDT poisoning. Completeness of vaporisation and a low degree of decomposition of the DDT incorporated in the cord are obtained by proper heat balances and by suitable physical structure of the cord. The concentration produced by burning one foot of cord, containing about 400 mg. DDT, for each 60 cu. ft. of space gave complete knockdown of *Musca domestica*, L., in 30 minutes. Since the vaporised DDT is suspended in the air as such small particles, the time required for complete deposition is 1–2 hours, which is considerably longer than that for atomised sprays or the ordinary aerosols. The thickness and weight of the deposit are determined by the vapour concentration and exposure time, and one hour of exposure produced a residue on screen cages that was effective for four weeks after treatment.

In tests in which caged flies were exposed in gas-tight chambers, exposure for 20 minutes to the vapour produced by burning 1 ft. of cord per 20 cu. ft. space gave 94–100 per cent. mortality in 24 hours, depending on the type of cage, and the height at which the cage was placed in the chamber made little difference. When the flies were introduced at various times after the vapour was released, it was found that there was little loss of toxicity for 40 minutes, after which it fell sharply but persisted in decreasing amounts for two hours. In further tests, burning 1 ft. of cord per 60 cu. ft. space gave 66, 86, 97.5 and 100 per cent. mortality after 24 hours with exposure times of 10, 14, 20 and 40 minutes, respectively, and exposure for 10 minutes to 1 ft. per 60, 30 and 15 cu. ft. gave 66, 83 and 97.5 per cent. Final mortality was about the same when the cord was burned in a special dispenser container with a screened vent, but the knockdown is stated to be improved. The deposits obtained in one hour in cages by burning the cord at 1 ft. per 50 and 25 cu. ft. gave high and very high mortality, respectively, of flies confined in them for 24 hours up to 18 days after treatment and were still fairly toxic after 49 days.

When fed adults of *Cimex lectularius*, L., were treated, exposure for 20 minutes to the vapour from 1 ft. of cord per 50, 60 and 100 cu. ft. space gave 77, 65 and 40 per cent. mortality after 48 hours and 100, 100 and 87 per cent. after 72. The deposit obtained in 40 minutes from cord burnt at 1 ft. per 30 cu. ft. gave complete mortality on metal in 24 hours and on wood and paper in 48.

In tests under natural conditions in buildings of various sizes infested with blowflies, *M. domestica*, *C. lectularius*, and other insects [cf. also *R.A.E.*, A **37** 187], including mosquitos and fleas, the cord used at the rate of 1 ft. per 50 or 60 cu. ft. space with an exposure time of two hours gave practically complete kills.

JONES (H. A.), MCCOLLOUGH (G. T.) & MORTON (F. A.). **Effect of Storage on Insect Repellents.**—*Soap & sanit. Chem.* **22** no. 10 pp. 151, 153, 3 refs. New York, N.Y., 1946.

Experiments were carried out on the effect of storage for eight months under various conditions (in amber-glass bottles, pyrex-glass flasks and tinned-metal cans at room temperature and at 60°C. [140°F.], in amber-glass bottles and in pyrex-glass flasks outdoors in sunlight and in tinned-metal cans in the freezing unit of a refrigerator) on the repellents known as 6-2-2 and 80-20. These are a mixture of 60 per cent. dimethyl phthalate, 20 per cent. 2-ethyl-1,3-hexanediol and 20 per cent. n-butyl mesityl oxide oxalate [*R.A.E.*, B **34** 10; **35** 190] and a mixture of 80 per cent. dimethyl phthalate and 20 per cent. 2-ethyl-1,3-hexanediol. Observations were made on the colour and refractive index of all samples, and the repellent values of the stored samples and fresh mixtures prepared from the same lots of ingredients were determined in paired tests [*cf.* **34** 25], using *Aedes aegypti*, L., and *Anopheles quadrimaculatus*, Say, as the test insects. The results were analysed statistically. The refractive indices of the fresh mixtures agreed with those of the test mixtures at the time they were prepared. The 6-2-2 mixture appeared to be affected by storage in metal cans both at room temperature and at 60°C. It became almost opaque at 60°C. and showed a marked change in colour even at room temperature. These two samples were the only ones of the 6-2-2 mixture that showed a significant decrease in repellent value against *Aedes*. Results against *Anopheles* were erratic. Samples of the mixture stored at 60°C. in amber-glass bottles and in pyrex showed no loss in repellent value. Under certain conditions, the mixture actually became lighter in colour on storage, but the change was not accompanied by any change in repellent value. The 80-20 mixture seemed to be affected very little by the conditions of storage used. No loss in repellent value to *Aedes* was indicated under any of the conditions. The sample stored in pyrex at 60°C. showed a definite loss in repellency to *Anopheles*, but this may have been due to contamination from the rubber stopper or some other cause.

GERSDORFF (W. A.) & BARTHEL (W. F.). **Determination of Pyrethrins Deterioration.**—*Soap & sanit. Chem.* **22** no. 10 pp. 155, 157, 1 ref. New York, N.Y., 1946.

In the course of work on the preparation of purified pyrethrum concentrates [*cf.* *R.A.E.*, B **33** 98], it was found that partly polymerised or altered samples of pyrethrum were no longer completely soluble in dichlorodifluoromethane, and tests were carried out to determine whether the relative amount of material insoluble in this solvent might be used as a criterion of the deterioration of highly concentrated pyrethrum preparations. The following is substantially the authors' summary. A purified pyrethrum concentrate (100 per cent. pyrethrins and cinerins) alone and with the addition of 0.1 per cent. hydroquinone, a sample diluted with deodorised kerosene to contain about 12 per cent. pyrethrins, and a commercial 20 per cent. concentrate were stored in the dark at 2 and 40°C. [35.6 and 104°F.] and in the light (but not direct sunlight) at room temperature. Periodical examinations were made for polymerisation by determining the solubility of the samples in dichlorodifluoromethane, and at the end of 170 days the toxicity of the samples to *Musca domestica*, L., was determined by the turntable spray method [**26** 246]. The results indicated that solubility in dichlorodifluoromethane was a good indicator of deterioration.

There was no loss in toxicity in any of the samples when they were stored in the dark at 2°C. At higher temperatures, they tended to lose toxicity in the absence of an inhibitor, and this loss was much greater in the samples of 100 per cent. pyrethrins than in the less concentrated materials. Hydroquinone

at a concentration of 0.1 per cent. proved to be a good inhibitor of loss of toxicity in this concentrate, and deodorised kerosene, used as a diluent, also inhibited loss of toxicity. The commercial concentrate showed considerable deterioration in 170 days at room temperature and still more at 40°C.

PETTY (B. K.). **Miscellaneous D.D.T. Studies, with special Reference to some common agricultural Pests.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 276, [1+]  
16 pp., 13 refs. Pretoria, 1946.

Tests of DDT for the control of insect pests in South Africa included one in which a 5 per cent. dust applied in the laboratory at a rate equivalent to 10 lb. per acre caused complete knockdown of *Glossina pallidipes*, Aust., within four hours and complete mortality after 12 hours. Other tests described include some to determine the persistence of deposits from DDT sprays on different surfaces commonly used in household construction, in which the test insect was a termite [see *R.A.E.*, A 37 179].

WILSON (S. G.). **Seasonal Occurrence of Ixodidae on Cattle in Northern Province, Nyasaland.**—*Parasitology* 37 no. 3-4 pp. 118-125, 2 figs., 8 refs. London, 1946.

The observations here recorded on the seasonal incidence of Ixodid ticks on cattle in Northern Province, Nyasaland, were made largely in 1943 and 1944 in conjunction with a survey of East coast fever [caused by *Theileria parva*]; this disease is still present, and the vector, *Rhipicephalus appendiculatus*, Neum., remains common after 14 years of dipping. It was desired to find whether dipping could be made more effective through a more intimate knowledge of the climatic requirements of the ticks. The physiography, climate and vegetation of the Northern Province are briefly described, and notes are given on the distribution of cattle and goats. The main species of ticks infesting cattle over the whole area are *R. appendiculatus*, *Amblyomma variegatum*, F., and *Boophilus* spp. *R. appendiculatus* is predominantly a cattle tick in the nymphal and adult stages, but the larvae appear to have other hosts. *A. variegatum* has a wide variety of hosts in its larval and nymphal stages, but both these stages feed well on cattle, sheep and goats. The adult occurs chiefly on domestic animals, attaching itself to the udder and flanks. The other main Ixodids are *R. capensis*, Koch, *R. tricuspis*, Dön., *Hyalomma impressum transiens*, Schulze, and *R. simus*, Koch, but only the adults of these attack cattle. *R. sanguineus*, Latr., is common on dogs but feeds on cattle at the beginning of the dry season. Adults of *Ixodes pilosus*, Koch, are found on cattle during the rains in small numbers only.

The following synopsis of the seasonal periodicity of the more important ticks is based on the author's summary. Most of the ticks have only one generation a year in Nyasaland, and the females engorge and oviposit only during a limited season. The species of *Boophilus*, all stages of which seem very resistant to climatic influences, are the only important exception, but as they are one-host ticks, they are relatively easily controlled by dipping. Males and females of *R. capensis* can maintain themselves successfully only during the hot dry months of September–November, when the average maximum temperature exceeds 80°F. and the average minimum ranges between 50 and 60°. The optimum month is October, with average maximum and minimum temperatures of 84 and 52.8°F., and a relative humidity ranging from 35 to 50 per cent. at 9 a.m. The females of *R. tricuspis*, *R. appendiculatus* and *A. variegatum* thrive in the hot wet season of December–March, when the relative humidity is high and nights are warm. Males of *A. variegatum* attack from September. Adults of *R. tricuspis* disappear first (in February) and seem therefore to prefer average maximum and minimum temperatures of above 80 and about 62°F. The climatic factors limiting engorgement and oviposition by *R. appendiculatus* and

*A. variegatum*, which stop about the end of March, might be either the cold nights from April onwards (with the monthly average minimum temperature below 60°F.) or low relative humidity or a combination of factors. The life-cycle of *R. appendiculatus* is intermediate between that of the seasonal ticks, *R. capensis*, *R. tricuspis* and *A. variegatum* and the non-seasonal *Boophilus* spp. The adults are found throughout the year, but their numbers are reduced from April to November and the females seldom engorge during these months. Under slightly different conditions of climate and vegetation, such as might occur in some adjacent territories or even on the lake-shore plain of Nyasaland, this species might be able to breed throughout the year, and there might be no such mortality of larvae as appears to occur in the plateau area after July, when the average monthly maximum temperature rises above 75°F.

Under the conditions of the cattle areas of the Nyasaland plateau, it appears that the best supplement to the programme of dipping would be energetic hand-picking of engorged females during their brief season, together with monthly changes of grazing grounds during the rains so that larvae may be left to perish. The shortest incubation period in the laboratory was 37 days. The choice of grazing grounds might be important, as the drier *Brachystegia* association should be less favourable than the *Acacia-Combretum* association, and grass fires might be organised to help destroy larvae. The relative importance as tick-breeding grounds of the different vegetation associations is difficult to assess. Native crops are grown for preference on ground occupied by the *Acacia-Combretum* association, so that cattle are debarred from this association over wide areas from about December to July. During these months, grazing is chiefly in the *Brachystegia* woodlands, and it could be assumed that females of *R. appendiculatus*, *R. tricuspis* and *A. variegatum* oviposit chiefly in the *Brachystegia* community. After July, cattle are herded on cultivated land to eat the crop residue and they also spend more time on the open dried-up grazing dambos along the streams, which are water-logged in the wet season. *R. appendiculatus* must therefore complete its life-cycle on these two types of land, neither of which is subjected to heavy grass fires. It is during this time also that cattle become infested with *R. capensis*. Mortality was high among nymphs of *A. variegatum* reared in the laboratory in the dry season at room temperature unless extra moisture was supplied. In nature, this moisture would be found in the dambos.

The probability of the periodicity found among ticks in Nyasaland applying in other parts of East Africa is discussed. It would not apply in areas with two rainfall seasons annually, in sea-coast belts with high relative humidity throughout the year, or in open grassland areas without bush cover. At Mwapwa in Tanganyika, where conditions are not very dissimilar from those at Lilongwe (the main recording centre in Northern Province, Nyasaland), E. A. Lewis found *A. variegatum* abundant from September to March. He also found that heavy infestations of *R. appendiculatus* occurred on stock farms in Kenya, where cultivation predominates, but that this tick was rare on grassy plains, high plateaux and desert areas. H. E. Hornby in Tanganyika found *Amblyomma* sp. almost everywhere at all times, whereas *R. appendiculatus* occurred throughout the year only in comparatively moist cool areas, and was hardly ever found in dry open thorn thicket [24-27]. There are no reports on the seasonal periodicity of ticks in Northern Rhodesia and Portuguese East Africa.

ARTHUR (D. R.) & EDWARDS (E. E.). **A Note on an unusual Male Tick from Glamorgan.**—*Parasitology* 37 no. 3-4 pp. 152-153, 6 figs., 2 refs. London, 1946.

A description is given of an unusual male tick recovered from rough vegetation during investigations on *Ixodes ricinus*, L., in South Wales. Only one individual

of the kind was found, though several thousand male ticks were examined in the course of three years. It did not mate when placed in a tube containing ten unfed females of *I. ricinus*, though in similar circumstances a typical male of that species mated within seven minutes of introduction into the tube.

LEES (A. D.). **Chloride Regulation and the Function of the Coxal Glands in Ticks.**—*Parasitology* **37** no. 3-4 pp. 172-184, 10 figs., 20 refs. London, 1946.

Blood-sucking Arthropods that ingest a large volume of liquid food presumably need to preserve the constancy of ionic composition of the internal medium while reducing the volume of the meal by eliminating water. As mammalian plasma has a high chloride content, and ticks ingest large blood-meals, a study was made of chloride regulation in *Ornithodoros moubata*, Murr., and *Ixodes ricinus*, L., chosen examples of Argasids and Ixodids, respectively. The former takes a large meal in about 30 minutes and at the same time discharges a large volume of watery fluid through the coxal glands. The latter ingests a far larger meal but requires about eight days to do so. It is clear that the coxal glands, which are present in some, if not all, Argasids and apparently absent in Ixodids, are concerned with ionic (chloride) regulation as well as with the ultra-rapid excretion of water. The literature on their morphology is reviewed, those of *O. moubata* are described at length and those of *O. delanoëi acinus*, Whittick, more briefly, the performance of their dual function is discussed with relation to their morphology, and the chloride exchanges in *I. ricinus* in the absence of coxal glands is examined.

The following is based on the author's summary of the findings. Following a blood-meal, *O. moubata* excretes about half the ingested water in the coxal fluid. The mean chloride concentration of the haemolymph is 1 per cent. sodium chloride before feeding and 0.96 per cent. after feeding, and that of the coxal fluid is 0.8 per cent. The production of coxal fluid is under muscular control. It is believed that the contraction of the muscles of the gland enlarges the filtration chamber and sets up a sufficient difference in pressure across the membrane to initiate filtration into the gland. In the subsequent passage of the fluid down the tubules, threshold substances such as chloride are reabsorbed. That the coxal fluid is primarily an ultrafiltrate of the haemolymph is suggested by the rapid passage of dyes and even haemoglobin into the coxal fluid after injection into the haemolymph and the very high rate of liberation of fluid. Serum albumin sometimes passes into the coxal fluid after injection, but casein and the normal haemolymph proteins are fully retained.

The mean haemolymph chloride concentration in unfed females of *I. ricinus* is 0.72 per cent. sodium chloride, and in the engorged females that have fed on sheep blood with a chloride concentration of about 0.5 per cent., it is 0.88 per cent. Dissection of partly engorged females showed that there are no coxal glands in this species. During the long engorgement period, the blood is concentrated in the gut mainly by the loss of water through the cuticle [*cf. R.A.E., B 36* 211]. In the absence of special regulatory organs, the tick displays a marked tolerance to increased haemolymph concentration. After desiccation, haemolymph chloride may rise to about 1.3 per cent. without signs of injury appearing.

GARNHAM (P. C. C.). **Acrodendrophilic Mosquitos of the Langata Forest, Kenya.**—*Bull. ent. Res.* **39** pt. 4 pp. 489-490, 5 refs. London, 1949.

Langata Forest, which has been shown to be a mild focus of yellow fever [*R.A.E., B 34* 92-93], is a small detached forest near Nairobi. It is of evergreen character, and the rainfall is low. Adults and larvae of *Aedes aegypti*, L., were

found in the forest during a mosquito survey in 1944, and two new species of *Aedes* were also collected there [35 95]. In 1946, observations were extended to the incidence of adult mosquitos in the upper strata of the forest. Each week from May 1946 until March 1947, six catches were made of females alighting between 5 and 8 p.m. and between 7 and 10 a.m. (twilight or just before or after) on an African child on a platform at a height of 30 ft. in the upper branches of a tree. Mosquitos rarely attacked man at other times of the day. The numbers of each of the eight species of *Aedes* taken are shown in a table; they included one female of *A. aegypti*, taken in the morning. By far the most abundant species was *A. deboeri*, Edw., of which 28 females were caught in the morning and 154 in the evening. Catches on platforms on another tree in the following year revealed a similar specific distribution. A wider range of species (including many *Culex*) was taken in ground catches during the same period, and their relative density was very different. Nearly 2,000 individuals of *A. dentatus*, Theo., were collected and only nine of *A. deboeri*. *A. deboeri* was most numerous in the platform collections immediately after the long rains. *A. africanus*, Theo., was not found at Langata, although *Craibia elliottii*, in which it characteristically breeds [cf. 34 93], is common. It is tentatively concluded that *A. deboeri* may be the local jungle vector of yellow fever.

MORRIS (K. R. S.) & MORRIS (M. G.). **The Use of Traps against Tsetse in West Africa.**—*Bull. ent. Res.* 39 pt. 4 pp. 491–528, 2 pls., 5 figs., 16 refs. London, 1949.

The following is mainly based on the authors' summary. From 1940 onwards, experiments were carried out in the savannah country in the northern Gold Coast on the trapping of *Glossina palpalis*, R.-D., and *G. tachinoides*, Westw., the most important vectors of sleeping sickness in West Africa. Their habitat is described with special reference to their feeding grounds, since those are the places where trapping can be most effective and control of the flies is most desirable. A new type of trap, called the animal trap, was designed to take advantage of the feeding habits of the two species, the main hosts of which in the country where sleeping sickness is prevalent are man and domestic animals. It consisted of fabric over a wooden framework with rounded wire "ribs", so that with the resulting high-lights and shadows, it simulated an animal's body. It was set on four wooden legs that were sunk into the ground and was surmounted by a catching cage covered with wire gauze. The underneath was left open to allow the flies access. The body measured 2 ft. long, 10 ins. high and 7 ins. wide and was raised one foot from the ground. Light brown or khaki covering was slightly better than black, and rough material was decidedly better than smooth.

Over long periods, the animal trap caught over 20 times as many flies as the Harris trap [R.A.E., B 19 78], which was not at all suitable for *G. palpalis* [cf. 36 145], about ten times as many as Swynnerton's ASB trap [a plain screen hanging from a cage with an awning and "buttocks" at the ends], and about seven times as many as Chorley's crinoline trap [21 202]. It was most effective in open feeding grounds such as ferries, fords, waterholes and animals' drinking places. The most important single factor for good siting is the regular presence of an abundance of hosts, and the nearer the traps can be placed to natural hosts the more effective they will prove. Traps are best placed with their axes at right angles to the regular lines of movement of the flies and should be visible from as many sides as possible. Traps about five yards from the edge of the fly-belt catch twice as well as traps against the bushes and considerably better than traps 40–50 yards out. Good lighting is an advantage but not essential. Good sites remain consistently good as long as the environment is unchanged, and bad sites remain bad. There is a tendency

for the numbers of flies caught to fall by as much as 70 per cent. during the first few weeks when traps are placed in undisturbed fly-belt. This is the effect of skimming off a part of the fly population in the immediate neighbourhood of the traps and does not represent a real reduction in population.

The effectiveness of groups of five traps operating continuously and of fly-boys working at the rate of 20 boy-days per month was compared. Traps were more effective than fly-boys in taking *G. tachinoides* and less effective in taking *G. palpalis* and *G. morsitans*, Westw. Fly-boys, however, caught a higher proportion of females of *G. tachinoides* but a lower proportion of females of the other two species. This may be because the traps resemble the regular hosts of *G. tachinoides* and so attract non-feeding males, as well as hungry flies of both sexes, whereas they do not resemble the preferred hosts of *G. palpalis* and *G. morsitans* and so attract only hungry flies. Traps appear to be more effective in comparison with fly-boys in groves and clearings where there are few flies than in or near extensive fly-belts where there are many. This is possibly the result of competition, which would be most evident in small tsetse populations and would favour the continuously present traps. The primary object of the investigation was to find a means of controlling *G. palpalis* and *G. tachinoides* in the sacred groves, which are pernicious foci for the dissemination of sleeping sickness since both villagers and tsetse gather there. Rigorous taboo opposes the cutting of any vegetation within them. They are fairly well isolated by open country and are very limited in extent.

Graphs of catches by fly-boys show a double-peaked curve with maxima at the beginning and in the middle of the wet season; those of catches by traps have a single peak towards the end of the dry season and a minimum during the rains. The efficiency of traps in relation to fly-boys is greatest in January and least in September. In an estimate based on all the available data and comparing 150 trap-days with 20 boy-days monthly, the traps at their best were ten times as good as the fly-boys, and at their other extreme one-fourth as good. It is considered that this maximum efficiency in the dry season is not due to the flies' being attracted to shade, but is a complex result of the circumstances that bring about optimum conditions for trapping in the dry season when the weather frequently puts fly-boys at a disadvantage, and the most adverse conditions for trapping in the wet season when they enjoy certain advantages of mobility. The seasonal rhythm of trap catches has demonstrated the presence of a considerably greater fly population in the height of the dry season than is suggested by the size of the fly-boy catches.

The practicability of using traps in the control of sleeping sickness to exterminate the tsetse, to reduce its population or to destroy feeding flies in contact with man is discussed. It was found that continuous catching by teams of four fly-boys could eliminate *G. palpalis* and *G. tachinoides* from small groves in 8-12 weeks, but that since none of the groves was completely isolated, repopulation took place by immigration, especially in the wet season. Small numbers of traps, 5-7 to the acre, made no apparent difference to limited tsetse populations; concentrations of about 20 to the acre caused considerable reductions and checked the effects of immigration, but did not achieve anything approaching extermination of the flies. Eradication by traps is impossible, but reduction of populations, if it can be effected over the main area of an epidemic, should partly control sleeping sickness. Small groups of well-placed traps in feeding grounds considerably reduce the numbers of active, hungry flies in contact with their hosts, although hardly affecting the main fly population. This should have a definite protective value to the community, which is enhanced by the increased catching powers shown by traps when close to man and animals and the tendency for people and tsetse to congregate around waterholes during the dry season, the time when traps are working at maximum efficiency. It is in this protective capacity that traps seem to have the greatest possibilities

for use in the control of sleeping sickness. The measure is applicable anywhere. Only small numbers of traps are needed at each place where infection is being transmitted, so that a reasonably big area can be covered economically. It might be a useful adjunct to clearings that fail to exclude the tsetse sufficiently. Traps so used might prove a valuable supplementary control measure in places, such as the forest, where clearing is unlikely to be easy or cheap. Finally, experiment has shown that hessian impregnated with DDT solution remains sufficiently toxic to *Glossina* when exposed to the weather to justify the application of DDT to the material covering the traps to increase their effect.

LEWIS (D. J.). *Glossina tachinoides* in north-east Africa.—*Bull. ent. Res.* **39** pt. 4 pp. 529–530, 10 refs. London, 1949.

*Glossina tachinoides*, Westw., is common in West Africa, its eastern limit being on the Shari River in French Equatorial Africa at about 18°E. long., and was recorded from Arabia (Aden) in 1906, but there was no proof of its occurrence over the intervening 27° (1,600 miles) until Ghidini recorded it from the Gambeila district of western Abyssinia in 1939 [*R.A.E.*, B **28** 142]. In March 1948, J. F. E. Bloss found a single female at Kigille (34° 04' E. long), near the border of the Gambeila district, in the Anglo-Egyptian Sudan. A wide gap still remains in the distribution of the species, and it is not known why it is absent from the tsetse-infested tributaries of the Nile system. However, the distribution of many insects in the Sudan is very discontinuous, apparently because of past changes in climate.

MICHENER (C. D.). **The Taxonomy and Bionomics of some Panamanian Trombidiid Mites (Acarina).**—*Ann. ent. Soc. Amer.* **39** no. 3 pp. 349–380, 59 figs., 7 refs. Columbus, Ohio, 1946. **Taxonomic and bionomic Notes on some Panamanian Chiggers (Acarina, Trombiculinae).**—*T. c.* pp. 411–417, 6 figs. **The Taxonomy and Bionomics of a new Subgenus of Chigger Mites (Acarina, Trombiculinae).**—*T. c.* pp. 431–445, 23 figs., 7 refs.

In the first of these papers, information is given on the classification and life-histories of the ALLOTHROMBIDIINAE, MICROTROMBIDIINAE and, for comparative purposes TROMBICULIDAE, which the author considers as also a subfamily of TROMBIDIIDAE, together with a list of nine species, six of which are described as new, taken in Panama. Notes are given on the habitats and local distribution of all of these and on the bionomics and the morphology of various stages of all except one. They include *Microtrombidium maculatum*, sp. n., which is always associated with *Pistia* and the larvae of which are parasitic on mosquitos. Engorged larvae were found attached to *Mansonia titillans*, Wlk., and *M. nigricans*, Coq., in Panama, but larvae did not attach themselves to *Anopheles albimanus*, Wied., when adult mosquitos were put in jars with the mites or when they emerged from pupae placed in a jar of water on the surface of which were many mites. Adults of another species, *M. pistiae*, sp. n., were observed apparently feeding on dead bodies of Chironomids floating on the surface of the water.

The species dealt with in the second paper are *Eutrombicula helleri*, Oudm., *E. vanommereni*, Schierbeek, *E. batatas*, L., and *Trombicula panamensis*, Ewing, which is transferred from *Eutrombicula* to *Trombicula*. All four are similar in number and general structure of the stages [*cf. R.A.E.*, B **37** 61], and information is given on their morphology and local distribution in Panama and the hosts of the larvae. In connection with the rearing of *E. batatas*, the author states that a far better method of feeding nymphs and adults than that used by him [*loc. cit.*] was devised by D. Jenkins, who, following G. W. Wharton, used insect eggs as food. It seems probable that these are the normal food of these stages.

In the third paper, the author discusses the status and characters of the genera *Trombicula* and *Eutrombicula* and erects a new subgenus of *Trombicula*, *Megatrombicula*, for three species that occur in Panama (including *T. alleei*, Ewing, the type, and one new species) and one species from Peru, which is known only from a single adult. Descriptions are given of the Panamanian species with notes on their habits and host records.

TRAPIDO (H.). **DDT Residual Spray Control of Sandflies in Panama.**—*J. econ. Ent.* **40** no. 4 pp. 472-475, 1 ref. Menasha, Wis., 1947.

*Culicoides* spp. occur in very large numbers in many parts of Panama and cause great annoyance. They pass readily through the wire screening ordinarily used against mosquitos, and the common way of trying to exclude them from screened buildings is to paint the screens with a non-volatile oil in order that dust may collect and reduce the size of the apertures. However, when the holes are small enough to exclude the midges they no longer admit sufficient air. Accounts are given of four experiments made between March and June 1945 on the use of solutions of 5 per cent. DDT in kerosene against *Culicoides*. Sample lots of midges biting during the tests were all identified as *C. furens*, Poey. The biting rate (number of bites in 15 minutes) at an outdoor control site on 44 evenings between 17th March and 15th June was always between 114 and 345 with one exception and showed that an abundant population of *Culicoides* was present in the area throughout the experimental period.

The biting rate in the screened room in which the first experiment was made averaged 34 on ten successive evenings when the apertures were considerably reduced by the effect of oiling some months previously and 60 after the screens had been brushed clean. It was 0 for 12 days following the painting of the screens with DDT solution and ranged from 0 to 11 for 11 weeks thereafter. Biting was not appreciable for 50 days. The next experiment concerned a whole barracks open on three sides except for mosquito screens. The biting rate on seven evenings before painting the screens averaged 21, and for the 90 days after treatment it ranged from 0 to 10, a considerable rise again being apparent after about 50 days. Some midges may have entered through the doors, which had to be opened frequently. In the third experiment, applying DDT solution to the exterior of the painted wood that formed the lower half of a guard shed about 8 ft. square and, 33 days later, to the screen that formed the upper half did not give adequate protection, as the average biting rate was reduced from 34 only to 17 before the second application and 19 for 47 days after it. Spraying the outside wall of a mess hall, the overhanging eaves and other adjacent surfaces within a radius of about 30 ft. with the DDT solution failed in the fourth experiment to bring about any effective reduction in annoyance in the area.

FURMAN (D. P.). **Toxicity of Benzene Hexachloride to Mammals.**—*J. econ. Ent.* **40** no. 4 pp. 518-521, 6 refs. Menasha, Wis., 1947.

The results are given of experiments carried out to obtain additional data on the risk involved in treating domestic animals with BHC (benzene hexachloride) for the control of ectoparasites. The toxicity to mice of commercial BHC containing approximately 12 per cent.  $\gamma$  isomer was relatively low when administered by means of a stomach tube or applied to the skin as a water suspension, and there was no evidence of marked cumulative action. No indication of toxic action was found when dry cows were given single doses of BHC at the rate of 0.05 or 0.074 gm. per kg. body weight, which is well above the range of probable ingestion in dipping procedures, or when cattle were dipped in suspensions containing 0.5 per cent. BHC.

Since a single dose of 0.6 gm. BHC per kg. bodyweight (approximately 72 mg.  $\gamma$  isomer) caused 37 per cent. mortality of mice, whereas none was killed by the administration of 80 mg. pure  $\gamma$  isomer per kg., it was obvious that the toxicity of BHC cannot be attributed entirely to the  $\gamma$  isomer, and since the material used in these tests contained approximately 12 per cent.  $\gamma$  isomer and 65–75 per cent.  $\alpha$  isomer, it seems probable that the toxicity of the mixture was largely due to the latter. The  $\gamma$  isomer has been shown to be about nine times as toxic as the  $\alpha$  isomer [cf. *R.A.E.*, B 33 131], and it might be assumed that over half of the total toxic effect on the mice of the mixture used was due to the latter. A direct interpretation of this type must be made with caution, however, as A. J. Lehman has pointed out that the  $\gamma$  isomer is a stimulant to the central nervous system, whereas the  $\alpha$  isomer appears to be more of a depressant. Thus the total toxicity may be far from the sum of the individual toxicities of the two components. It has been found [by B. P. McNamara & F. Hopkins] that the  $\beta$  and  $\delta$  isomers are also depressants, indicating that there may be some antagonism of action between these and the  $\gamma$  isomer.

BRUCE (W. N.) & DECKER (G. C.). **Fly Control and Milk Flow.**—*J. econ. Ent.* 40 no. 4 pp. 530–536, 4 figs., 2 refs. Menasha, Wis., 1947.

Two dairy herds in Illinois were treated three times during the season at intervals of three or four weeks for the control of flies with a spray containing water-wettable DDT, applied at the rate of 28 gm. DDT per cow, two others were similarly treated with Rhothane (dichlordiphenyldichlorethane), four were treated daily with small amounts of DDT, and four control herds received commercial repellent-type sprays of oil containing small amounts of pyrethrins and thiocyanates. The heavy applications to leave a toxic residue did not give adequate sustained control of stable flies [*Stomoxys calcitrans*, L.] though control of horn flies [*Siphona irritans*, L.] was satisfactory, but daily applications of 0.23 gm. DDT per cow gave good control of stable flies and eliminated horn flies. Increasing the dosage to 0.49 gm. did not give any significant extra control of stable flies. It is suggested that the best treatment might be a heavy application to reduce the population followed by small daily applications to keep it low. All herds treated with DDT or Rhothane maintained better milk production than the herds that received the repellent sprays. The benefit of spraying was more marked in poorly managed herds that depended largely on pasture for food than in well managed ones receiving heavy supplemental rations. There was a significant inverse correlation between changes in milk production and fly abundance.

As differences in herd management and in the milk production gradients of individual cows in a herd resulting from differences in the stage of lactation made it difficult to establish the significance of the effect on milk production of treatments applied to whole herds, further observations were made on selected cows in similar stages of lactation in herds that had been sprayed daily with DDT, Rhothane or chlordane. Correlation between abundance of stable flies and horn flies and changes in milk production was highly significant. All three chemicals were effective, with no practical difference between them.

LINDUSKA (J. P.) & MORTON (F. A.). **Determining the Repellency of solid Chemicals to Mosquitoes.**—*J. econ. Ent.* 40 no. 4 pp. 562–564, 3 refs. Menasha, Wis., 1947.

Solid chemicals were tested as mosquito repellents in 1944 because their comparatively low vapour pressure and rate of absorption by the skin might make them more satisfactory than liquids. It was found that a valid measurement of the repellency of materials on fabric could be obtained only when the

fabric was in contact with the skin. Adequate results for screening tests were obtained by impregnating mercerised cotton hose to a length sufficient to cover the forearm with 2 gm. of the chemical as a 10 per cent. solution in acetone or an alternative solvent (about 3.3 gm. per sq. ft.), and exposing the arm covered with the stocking each day for two minutes in a cage containing several thousand hungry females of *Aedes aegypti*, L., and in one containing similar females of *Anopheles quadrimaculatus*, Say, until five bites had been received from each species. The biting rate on the bare untreated forearm was 50-75 in 30 seconds for *Aedes* and about 25 for *Anopheles*. Records were kept of the number of days of complete protection (up to the first bite) and of partial protection (up to the fifth bite). Dimethyl phthalate (the standard) gave an average protection of over 30 days against *Aedes*. Chemicals that gave partial protection against *Aedes* for ten days were considered to justify further study. In tests of more than 6,000 compounds, *Anopheles quadrimaculatus* was found to be insensitive to many materials that repelled *Aedes aegypti*. No compounds were found that gave significantly greater protection against *Anopheles* than against *Aedes*. Consequently, interpretations of repellency were made largely in terms of performance against *A. aegypti*.

Solids sufficiently repellent to warrant additional consideration were subjected to irritation tests. After this, 48 were tested on the skin, as solutions in dimethyl phthalate or as suspensions in distilled water. The procedure used was essentially that described by Granett [*R.A.E.*, B 29 65]. One ml. of solution or suspension was applied to the forearm and dimethyl phthalate was used as control. Out of 45 solids tested in dimethyl phthalate, 28 extended the protection time of that material. In water suspension, 14 materials were equal to or better than dimethyl phthalate and 23 inferior. In four tests, n-butyl sulphone (31 per cent.) as an aqueous suspension gave an average protection time against *A. aegypti* of 426 minutes. The same material (33 per cent.) in dimethyl phthalate gave protection for an average of 318 minutes. Dimethyl phthalate alone protected for 273 minutes.

When cloth impregnated with materials found effective in screening tests was rinsed in tap water at 75-85°F., more than half of the solids subjected to this treatment were ineffective after 15 minutes of rinsing and only seven retained repellent action after rinsing for 30 minutes or more, the best being dinitro-o-sec.-butylphenol, which was still effective against *A. aegypti* after 105 minutes of rinsing and seven changes of water. A list is given of 14 materials that remained effective for more than 10 days when applied to cloth at 1.65 gm. per sq. ft. They include dinitro-o-sec.-butylphenol but not n-butyl sulphone.

**SWEETMAN (H. L.). Comparative Effectiveness of DDT and DDD for Control of Flies.**—*J. econ. Ent.* 40 no. 4 pp. 565-566, 11 refs. Menasha, Wis., 1947.

During 1946, sprays prepared from 25 per cent. emulsion concentrates of DDD [dichlordiphenyldichlorethane] and DDT were compared for the control of flies on two dairy herds of about 60 cows each in Massachusetts. Horn flies [*Siphona irritans*, L.] became noticeable on both herds in late June, and one herd received three sprays containing 0.2 per cent. DDD between 1st July and 18th August and one containing 1 per cent. on 5th September, and the other received five sprays containing 0.2 per cent. DDT between 27th June and 18th August and one containing 1 per cent. on 3rd September. Control on both herds was excellent. A few stable flies [*Stomoxys calcitrans*, L.] appeared in August at the barn used by the herd treated with DDT but were quickly eliminated by spot treatment of the wall and the manure conveyor system with a 1 per cent. spray. House-flies [*Musca domestica*, L.] were scarce at this barn but became temporarily conspicuous at the other herd's barn twice during the summer. Limited spot treatments with DDD quickly eliminated them.

The results are thought to indicate that either DDT or DDD applied to livestock at about 1 per cent. at intervals of about a month will control *Siphona* under Massachusetts conditions, and that similar applications on very limited areas of the barn walls and milk room screens and other places where flies congregate will control *M. domestica* and *Stomoxys*.

THURMAN (D. C.) & MULRENNAN (J. A.). **Occurrence of the Brown Dog Tick on Florida Rats.**—*J. econ. Ent.* **40** no. 4 pp. 566–567, 3 refs. Menasha, Wis., 1947.

Two mice, four examples of *Mus (Rattus) rattus alexandrinus* and 27 of *M. (R.) norvegicus* taken in Florida in 1945 and 1946 each harboured a single larva of *Rhipicephalus sanguineus*, Latr., two of *M. norvegicus* harboured two larvae each and one harboured eight larvae and 12 nymphs. This is thought to be the first record of *R. sanguineus* from these rodents. None of the larvae was engorged, but several nymphs appeared to be slightly engorged.

PIQUETT (P. G.), NELSON (R. H.) & MCGOVAN (E. R.). **Synergism in Pyrethrum-Piperonyl Cyclohexenone Roach Powders.**—*J. econ. Ent.* **40** no. 4 pp. 577–578, 3 refs. Menasha, Wis., 1947.

An account is given of an experiment on the effect of adding "piperonyl cyclohexenone", a trade product consisting of a mixture of two compounds and other condensation products, to pyrethrum powder for the control of cockroaches. The insecticidal dusts were prepared by impregnating fuller's earth with acetone solutions of various amounts of pyrethrum extract containing 16.44 per cent. w/v pyrethrins and the piperonyl cyclohexenone, evaporating the mixture to dryness and sifting. The method of testing was the same as that of McGovern & Piquett [*R.A.E.*, B **37** 102], except that the large crystallising dish was lined with kraft paper; the rate was 30 mg. per dish. The mortality percentages of adult females of *Periplaneta americana*, L., in ten days were 2 for 0.3 per cent. pyrethrins alone, 5 for 3 per cent. piperonyl cyclohexenone alone, and 83, 98 and 63 and 77, 45 and 27 for 3, 1.5 and 0.75 per cent. piperonyl cyclohexenone combined with 0.3 and 0.15 per cent. pyrethrins, respectively. The difference required for significance was 28.

SNYDER (F. M.) & MORTON (F. A.). **Benzyl Benzoate-Dibutyl Phthalate Mixture for Impregnation of Clothing.**—*J. econ. Ent.* **40** no. 4 pp. 586–587, 2 refs. Menasha, Wis., 1947.

An account is given of studies in Florida to determine whether a mixture of benzyl benzoate and dibutyl phthalate would be as satisfactory as benzyl benzoate alone for impregnating clothing against Trombiculids and if so what were the best proportions in which to combine them so as to conserve supplies of the benzoate. For the preliminary tests, bleached cotton twill was impregnated with 2 gm. per sq. ft. of mixtures of benzyl benzoate and dibutyl phthalate (75:25, 50:50 and 25:75) with acetone as solvent or diluent. Control cloths were impregnated with the two chemicals alone. The time required to paralyse Trombiculid larvae confined on the impregnated cloths was determined before and after the cloths were washed in warm, soapy water. The 50:50 and 75:25 mixtures withstood the same number of washes as benzyl benzoate alone and one more wash than the 25:75 mixture and dibutyl phthalate alone. The 50:50 mixture was therefore chosen for further testing.

Subsequent experiments showed that it was as resistant to washing as benzyl benzoate alone when used at 2 gm. per sq. ft. as an emulsion or solution to impregnate dyed woollen fabrics and cotton herringbone twill as used for

United States army uniforms and shirts and fatigue suits; both withstood more washes on the cotton than the woollen materials and when used in emulsions than when used in solutions. In the emulsion, the emulsifier was 0.2 per cent. Tween 80 [cf. *R.A.E.*, B 36 89], and the solvent was acetylene tetrachloride. When the cotton and woollen cloths were impregnated with 2 and 3 gm. chemical, respectively, in acetone (8 per cent. of the dry weight of the cloth in both cases), the results with cotton were still much superior to those with wool.

Tested under field conditions, on woollen and cotton uniforms impregnated by hand dipping with 5 per cent. emulsions, put through a wringer and then allowed to dry and subsequently washed for ten minutes in soapy water at 100°F. and twice rinsed for five minutes in cool water, with wringing after each immersion, both the benzyl benzoate and the 50-50 mixture on cotton uniforms gave 99-100 per cent. protection in one hour's exposure in a heavily infested area after two washes. On wool, they gave 100 per cent. protection after one wash and 92 per cent. after two. Woollen uniforms impregnated with the mixture gave complete protection after storage for 58 days outdoors or indoors wrapped in paper. Cotton uniforms impregnated with the mixture and benzyl benzoate gave complete protection after 58 days when aged indoors, but when kept outdoors, they gave complete protection after 50 but not 58 days when treated with the mixture and after 17 but not 38 with benzyl benzoate alone.

BRUCE (W. G.). **The Tail Louse, a new Pest of Cattle in Florida.**—*J. econ. Ent.* **40** no. 4 pp. 590-591. Menasha, Wis., 1947.

*Haematopinus quadripertusus*, Fahrenholz, was observed on cattle in Florida in August 1945, and surveys during the next two years showed that it was widespread in the State and was a serious pest in its central and southern areas. It was described from the Cameroons in 1916, but has apparently not been recorded elsewhere. In Florida, the adults were found only in the brush of the tail and in the ears; they were hardly ever observed on the ears of mature animals, but quite frequently occurred in those of calves, having probably transferred from the tail of the dam during suckling. Very great numbers of eggs were found on the hairs of the brush and occasionally a few scattered ones in the ears and round the tailhead. What appeared to be the first instar of this louse was frequently observed attached around the vulva and anus of cows, and the second and third instars were seen in the general area under the tailhead, where the skin is thin.

*H. quadripertusus* is a more serious pest of cattle than other lice. Animals harbouring heavy infestations are rapidly sapped of their vitality and some become too feeble to walk. The effects are most serious in yearlings. Neither 0.2-0.5 per cent. DDT as a suspension nor arsenical dips, which are used to control other cattle lice in Florida, had any effect on *H. quadripertusus*, but excellent control was obtained by spraying the infested cattle, including the tail brush, with a suspension containing 1.5 per cent. DDT at the average rate of 1.6 U.S. pints per animal.

THURMAN jr. (D. C.) & MULRENNAN (J. A.). **Sarcoptoid Mites on Rats in Florida.**—*J. econ. Ent.* **40** no. 4 pp. 591-592, 1 fig., 2 refs. Menasha, Wis., 1947.

The finding of 87 females of *Dermatophagoides crassus*, Can., in three collections of mites from *Mus (Rattus) norvegicus* in Florida in 1946 is recorded. This species, which infests birds, is not known to have been previously collected from rats, and its occurrence on them is thought to have been accidental. However, the bird host was not found.

BRETT (C. H.) & HODNETT (E. M.). **Chlorinated Extract of *Amorpha fruticosa*.**—*J. econ. Ent.* **40** no. 4 p. 593, 2 refs. Menasha, Wis., 1947.

Various attempts have been made to increase the toxicity of extracts of *Amorpha fruticosa* to insects [cf. *R.A.E.*, B **36** 6, 89], and the most striking effect has been obtained by chlorination. The method is described. The standard solution used for tests contained the chlorinated extract of 1 gm. fruits per cc. When the insides of wooden boxes were painted with this solution, at the rate of 10 cc. per 100 sq. ins., house-flies [*Musca domestica*, L.] could only be forced to enter them with difficulty, and when inside dropped almost immediately and died in less than a minute. Caged flies put in the boxes so that they were unable to touch the sides also died almost immediately, indicating that the compound had a fumigant action. Aeration of the boxes out of doors for one, two and four hours, increased the times required for complete kill of flies to about 5, 10 and 30 minutes, respectively; after aeration for 24 hours flies did not die faster in the painted boxes than in untreated ones. The same tests were made with adults of *Aedes aegypti*, L., with very similar results. To test its effect on mosquito larvae, a jet of the solution was forcefully squirted into water, which resulted in the formation of small droplets that settled out rather rapidly. Larvae put into water thus treated with the solution at the rate of 1:99 were not affected immediately, possibly owing to the insolubility of the compound in water, but were attracted to the small droplets and fed on them, and began to die at the end of eight hours. All were dead after 24 hours.

People working with this material experienced dull headaches after about four hours and strong irritation of the eye, nasal and throat membranes for several minutes after breathing the fumes from it.

HIXSON (E.) & MUMA (M. H.). **Toxicity of certain Insecticides to the Chicken Mite.**—*J. econ. Ent.* **40** no. 4 pp. 596–598, 3 refs. Menasha, Wis., 1947.

The various tests described in this paper were carried out in Nebraska to find a more practical and effective material for the control of *Dermanyssus gallinae*, Deg., on fowls than any of those now in use. Of the latter, the most effective is a tar distillate (carbolineum), used to treat the fowl houses, but it is disagreeable to apply and affects the flavour of the eggs for several days after use in a laying house. In the first tests, in which mites were exposed on a layer of dust in a covered petri dish, 5 per cent. azobenzene and 5 per cent.  $\gamma$ BHC ( $\gamma$  isomer of benzene hexachloride) caused complete mortality in 12 hours, but 2 and 5 per cent. chlordane caused no mortality in 48 hours. When batches of fresh mites were placed at intervals in open petri dishes on filter paper that had been sprayed with suspensions or solutions of toxicants and dried, 0.25, 0.5, 1 and 2 per cent. DDT in suspension in water and 0.25, 0.5 and 1 per cent. in solution in kerosene caused total mortality for 17, 23, 24, 47, 16, 21 and 47 days, respectively. The three longest tests were terminated for lack of mites. Pentachlorophenol at 2 and 5 per cent. in alcohol and at 2 per cent. in kerosene and in kerosene emulsion gave complete mortality for 42, 41, 21 and 26 days, respectively. Undiluted carbolineum killed all mites for 26 days. Solutions of 0.125–1 per cent. azobenzene in kerosene, 2 and 5 per cent. azobenzene in ethyl alcohol, 2 and 5 per cent.  $\gamma$  BHC in ethyl alcohol, 5 per cent. benzyl benzoate in kerosene, 0.25–1 per cent. pentachlorophenol in kerosene and kerosene alone gave complete mortality for 1–10 days. Azobenzene and BHC were less effective on painted woods and smooth unpainted wood than on rough wood or press board (Celotex). Pentachlorophenol, carbolineum and DDT were not affected by surface within the duration of the experiment.

Tests in which breeding houses and two of the four hens occupying each of them were sprayed with 5 per cent. pentachlorophenol in Stoddards solvent or ethyl alcohol,  $\gamma$  BHC in water or DDT in water showed that the only material that adversely affected the hens was pentachlorophenol in Stoddards solvent, which caused them great distress, though they had recovered by the following morning. The hens were infested by unidentified lice when introduced into the houses; all these were dead in 48 hours on the unsprayed hens in the house treated with DDT and in 24 hours on all other hens. Dead and living lice were found after 48 hours on fresh hens introduced into the houses treated with pentachlorophenol four days after treatment, but only dead lice on hens introduced at the same time into the other houses.

Azobenzene was the only material tested that killed the eggs of the mite. BHC was irritating to the nose and eyes when sprayed and had a disagreeable and persistent odour, but its effect on the flavour of the eggs was of short duration. DDT did not affect the odour or taste of the eggs, and its ease of use, relatively low toxicity to hens and effectiveness against lice and flies are desirable qualities. Pentachlorophenol was irritating to use for short periods, but less so than carbolineum, and its effect on the flavour of the eggs was not lasting. It is concluded that, on the basis of these tests, DDT [cf. 37 44] and pentachlorophenol are both superior to carbolineum for the control of *D. gallinae*.

BROWN (A. W. A.). **A DDT Emulsion Dip to control Goat Lice.**—*J. econ. Ent.* **40** no. 4 p. 605, 1 ref. Menasha, Wis., 1947.

In view of a report that a dip containing 0.3 per cent. DDT as an emulsified solution gave complete kill of lice on goats [*R.A.E.*, B **32** 205], 450 goats, 400 of which were of the Angora type, were dipped in an emulsion containing 0.25 per cent. DDT, 2.5 per cent. xylene and 0.6 per cent. laundry soap in Alberta in August 1945. Most of the goats were heavily infested with *Damalinea (Bovicola) limbata*, Gerv., in all stages of development. The animals were held in the dip for 15 seconds and their heads were immersed momentarily. After 24 hours, many lice were dead, but 32 of the 100 goats sampled showed light surviving infestations. No living lice were found on any of the goats sampled 48 hours or two weeks after dipping. In a final examination 15 weeks after dipping, one louse was found on each of four of the 100 goats examined, two goats showed 0.1 louse per sq. in. and one 0.5 per sq. in. The only effect of the dip on the goats was a temporary and scarcely perceptible eye inflammation.

GILROY (A. B.). **Malaria Control by coastal Swamp Drainage in West Africa.**— $8\frac{3}{4} \times 5\frac{1}{2}$  ins., viii+97 pp., 20 pls., 21 figs. (3 fldg.), 3 maps (1 fldg.), 5 refs. London, Ross Inst. trop. Hyg. [1948.]

In this handbook, which is written primarily for malariologists without special engineering training, instructions for draining swamps as an anti-malaria measure are given on the basis of experience gained in the draining of 6 sq. miles of swamps in the urban district of Lagos, Nigeria, for the eradication of *Anopheles melas*, Theo. [*R.A.E.*, B **35** 4]. In 1942, before the work began, 500 blood-fed females of *A. melas* were taken day after day in each one-man tent of an Anti-Aircraft Battery stationed within the area at Apapa, while during the year preceding publication of this book, the average *Anopheles* density at Apapa seldom exceeded 1 and was usually about 0.3 per catching station, per room, per day.

Details of planning, installing and operating the drainage system and using the drained areas and of the organisation of the swamp drainage team, which occupy most of the book, are preceded by notes on the vectors of malaria in West Africa (*A. melas* in the tidal swamps and *A. gambiae*, Giles, in association

with human dwellings and activities), the tidal swamps and their zones and Anopheline breeding in relation to them, and the impossibility of effecting control with larvicides. There are also sections on the financial and legal aspects of swamp drainage and the maintenance of drained swamps, appendices on administrative details, specimens of forms, diagrams and a quotation from relevant Nigerian legislation.

#### PAPERS NOTICED BY TITLE ONLY.

- MARTIN (J. T.) & BRIGHTWELL (S. T. P.). **The Determination of the Pyrethrins in Pyrethrum Concentrates in Mineral Oil.**—*J. Soc. chem. Ind.* **65** p. 379 repr. 9 pp., 11 refs. London, 1946. [See *R.A.E.*, A **37** 184.]
- BRAY (G. T.) & LORD (K. A.). **The Determination of the Pyrethrin Content of dilute Preparations of Pyrethrum Flowers in Oil.**—*J. Soc. chem. Ind.* **65** p. 382 repr. 5 pp., 2 refs. London, 1946. [See *R.A.E.*, A **37** 184.]
- GREEN (N.) & CARTER (R. H.). **Pyrethrin I Determination. The Effect of Light in causing Variations in experimental Results.**—*Soap & sanit. Chem.* **22** no. 7 pp. 148A, 148C, 10 refs. New York, N.Y., 1946. [See *R.A.E.*, A **37** 185.]
- DONOVAN (C. G.). **The Determination of DDT. A Review of analytical Methods for the Determination of DDT in the technical and pure Compounds and in various Insecticides, by total Chlorine Procedures.**—*Soap & sanit. Chem.* **22** no. 6 pp. 165, 167, 201, 4 refs. New York, N.Y., 1946.
- NEAL (P. A.) & VON OETTINGEN (W. F.). **Toxicity of DDT. A Report on experimental Studies.** [A review of the literature on toxicity to man and other mammals.]—*Soap & sanit. Chem.* **22** no. 7 pp. 135, 137, 139, 141, 143, 23 refs. New York, N.Y., 1946.
- MARTIN (Hubert). **Insecticides [including DDT and related compounds, rotenone and pyrethrum synergists] : chemical Constitution and Toxicity.**—*J. Soc. chem. Ind.* **65** p. 402 repr. 4 pp., 44 refs. London, 1946. [See *R.A.E.*, A **37** 184.]
- WINTERINGHAM (F. P. W.) & HARRISON (A.). **The Permeability of proofed Fabrics to Fumigants.**—*J. Soc. chem. Ind.* **65** p. 409 repr. 4 pp., 2 figs., 4 refs. London, 1946. [See *R.A.E.*, A **37** 184.]
- BEAMENT (J. W. L.). **The Penetration of Insect Egg-shells. II.—The Properties and Permeability of sub-chorial Membranes during Development of *Rhodnius prolixus*, Stål.**—*Bull. ent. Res.* **39** pt. 4 pp. 467–488, 9 figs., 27 refs. London, 1949. [See *R.A.E.*, A **37** 217.]
- ARTHUR (D. R.). **The Feeding Mechanism of *Ixodes ricinus* L.**—*Parasitology* **37** no. 3–4 pp. 154–162, 15 figs., 26 refs. London, 1946.
- NAGEL (R. H.) & GRANOVZKY (A. A.). **A Turntable Light Trap for taking Insects [including mosquitos] over regulated Periods.**—*J. econ. Ent.* **40** no. 4 pp. 583–586, 2 figs., 1 ref. Menasha, Wis., 1947. [See *R.A.E.*, A **37** 210.]

STILES (G. W.). **Anaplasmosis in Cattle.**—*Circ. U.S. Dep. Agric.* no. 154 (revd.), 11 pp., 3 figs., 1 ref. Washington, D.C., 1946.

In this revision of a circular already noticed on anaplasmosis in cattle in the United States [cf. *R.A.E.*, B 28 204, etc.], one additional tick (*Argas persicus*, Oken) is included in the list of those that have transmitted the disease experimentally [31 176], and reference is made to further work in which experimental infection was effected by additional species of *Tabanus* [cf. 30 100], to the incrimination of *Stomoxys calcitrans*, L., as a vector by Sanders in 1933, and to experimental transmission by mosquitos, principally species of *Psorophora* [30 10].

COLE (L. C.) & KOEPKE (J. A.). **A Study of Rodent Ectoparasites in Mobile, Ala.**—*Publ. Hlth Rep.* 61 no. 41 pp. 1469–1487, 1 fig., 40 refs. Washington, D.C., 1946.

This report on a survey of ectoparasites of rodents in Mobile, Alabama, in 1934 [cf. *R.A.E.*, B 36 190] is the second intracommunity analysis of data collected simultaneously in several communities. The arrangement of the previous report of the series [35 10] has been followed so far as local conditions allow, and the tables are in substantially comparable form. Hosts were collected alive on 266 days between 22nd January and 27th December; those other than domestic rats were not numerous and are not included in the study. The rats taken comprised 5,966 individuals of *Mus (Rattus) norvegicus*, 13 of *M. (R.) rattus rattus*, and 178 of *M. (R.) r. alexandrinus*. A rodent eradication programme carried out in the first half of the year did not apparently cause any significant increase in parasite indices on survivors, but it showed that though *M. norvegicus* seemed to be definitely the predominant domestic rodent, its predominance was greatly overestimated by live trapping, chiefly at the expense of mice. Infestation rates were determined for 6,123 of the rats collected alive. The fleas from all of them and the lice and mites from every tenth rat were identified. Of the fleas, 28,855 were *Xenopsylla cheopis*, Roths., 7,292 *Echidnophaga gallinacea*, Westw., 4,081 *Leptopsylla segnis*, Schönh., 3,846 *Nosopsyllus fasciatus*, Bosc, 992 *Ctenocephalides felis*, Bch., 25 *Rhopalopsyllus gwyni*, Fox, and six *Pulex irritans*, L. Of the mites, 1,727 were *Laelaps hawaiiensis*, Ewing, 733 *Echinolaelaps echidninus*, Berl., 43 *Eulaelaps stabularis*, Koch, 31 *Liponyssus bacoti*, Hirst, 10 *Atricholaelaps glasgowi*, Ewing, and 48 unidentified. Of the Anoplura, 1,996 were *Polyplax spinulosa*, Burm., 1,238 *Hoplopleura* spp. and five unidentified.

The data for these ectoparasites were examined statistically, the constants used being the same as in the earlier paper. The monthly and annual means and infestation rates of all fleas and of the five chief species separately, with the adjusted indices of *X. cheopis*, for the two species of rats are given in tables and discussed. Similar data are given for mites and Anoplura. There was a considerable tendency for the figures from different parts of the city and from different types of premises to fluctuate simultaneously, and it was thought that the causes of the fluctuation were probably meteorological. The mean temperature, total precipitation and mean relative humidity in Mobile for each month of 1934 are shown, together with the corresponding averages over previous years. Values for *X. cheopis* and *Laelaps hawaiiensis* were higher and those for *N. fasciatus*, *Leptopsylla segnis* and *P. spinulosa* lower in the warmer half of the year than in the colder half. The coefficients of correlation between biometric constants of these species and temperature were highly significant, but there were no significant differences in values for *Echidnophaga gallinacea* and a negative correlation shown by *C. felis* was significant only in the mean. There was very little correlation between the constants and

rainfall or humidity, but negative correlations for the means of *L. segnis* and *P. spinulosa* and humidity were significant.

Comparison between residential and other zones showed that *X. cheopis* was significantly associated with the commercial zone and *E. gallinacea* with the residential zone. There was no significant association of *Laelaps hawaiiensis* with the commercial zone in Mobile [cf. 35 11]. *X. cheopis* and *Leptopsylla segnis* were significantly more abundant on rats caught indoors than out. *Laelaps hawaiiensis* showed the same tendency, but it was statistically significant only in the case of the mean. *X. cheopis* was significantly associated with food-handling business establishments as opposed to residences, while *N. fasciatus*, *E. gallinacea* and *C. felis* were most abundant in association with residences.

REMPEL (J. G.) & ARNASON (A. P.). **An Account of three successive Outbreaks of the Black Fly, *Simulium arcticum*, a serious Livestock Pest in Saskatchewan.**—*Sci. Agric.* 27 no. 9 pp. 428-445, 7 figs., 8 refs. Ottawa, 1947.

Periodic outbreaks of *Simulium arcticum*, Mall. (*simile*, Mall.) have caused serious losses of livestock in Saskatchewan during the last few decades, particularly in 1913, 1919, 1930 and 1944-46. They have been centered in the area north of Saskatoon along the South Saskatchewan River to its junction with the North Saskatchewan. Descriptions are given of the outbreaks that occurred in 1944, 1945 and 1946. They took place in late May or June, and deaths of livestock occurred only on a few days. The numbers killed were 133 in 1944 [*R.A.E.*, B 35 8], about 70 in 1945, and about 600 in 1946. Losses occurred chiefly among mature cattle and shorn sheep; some calves and horses and a few pigs were killed, but calves and unshorn sheep were largely protected by their thick hair or wool.

Observations showed that *S. arcticum* breeds in the rapids of the South Saskatchewan river [cf. 10 181]. Rocky beds are extensive between Saskatoon and the junction but quite rare in the North Saskatchewan above Prince Albert, where the valley is deep and wide with extensive sand and mud flats. The main breeding areas are described, and data are given on the weather in the three periods of outbreak. The attacks in 1944 followed strong winds from the direction of an area where there was evidence of extensive breeding, the first of the two in 1945 followed winds from the same area and those in 1946 steady winds from areas 30-60 miles away, where breeding is known to occur. Losses in 1946 were concentrated in two areas some 60 miles from the main breeding places, and did not occur for 30 miles on either side of the river. It seems that most of the females that have been borne for long distances by wind do not get back to the main breeding areas to oviposit, and that the population is maintained largely by those that can be seen near the river throughout the summer.

The females commonly congregate, sometimes in enormous numbers, on the less hairy parts of the body of an animal, predominantly in sheltered places during daylight on hot sunny days. An attack was only once observed in a barn; and the barn was unusually well lit. Animals that have been attacked are restless and sometimes stampede, but as there is no pain at the time of feeding, this does not give them any protection. Milk production of cows is sometimes lowered by half. In addition to the oedematous lesions at the site of the bite, the commonest symptoms in sick animals [cf. 4 158] are a dropsical swelling in the region of the throat (and in horses occasionally swellings on the lower surface of the body) and heavy and rapid breathing. Animals appear to develop immunity with repeated attacks [cf. 31 85]. The use of larvicides is impracticable, as it would involve treatment of a large river for a distance

of over 100 miles, and reliance must be placed on protection of the livestock during the period when attack is likely (25th May to 15th June), by such methods as keeping valuable animals in dark stables, providing smudge fires, the smoke from which affords considerable protection in open pasture, and using repellents.

Although *S. arcticum* does not readily attack man, it was occasionally recorded to have done so during the survey, severe swelling and irritation resulting in each case.

MACKERRAS (M. J.) & MACKERRAS (I. M.). **Simuliidae (Diptera) from Queensland.**—*Aust. J. sci. Res. (B)* **1** no. 2 pp. 231–270, 2 pls., 14 figs., 14 refs. Melbourne, 1948.

As a result of a study made between February and June 1947, descriptions are given of the larvae, pupae, cocoons and adults of both sexes of eight Simuliids from Queensland and the egg of one of them and the female of the ninth species known from the State. Four species and one subspecies are new. The distribution of all in Queensland is given, together with brief notes on the taxonomy of some and the bionomics of most. Keys are included to the adults and larvae and illustrations for separating older larvae and pupae.

Only *Austrosimulium bancrofti*, Taylor, and *A. pestilens*, sp. n., which was formerly confused with it, are known to attack man and domestic animals, and only the latter is a serious pest. It attacks man, cattle, horses, sheep and dogs equally readily. Sheep or cattle mill round in mobs, stirring up clouds of dust that afford them some protection, but horses crowd into fires for protection and often get burnt. Lambs and calves become separated from their mothers and this is the main cause of deaths. Larvae and living pupae of *A. pestilens* were found only in fast, turbulent, muddy water during the height of the floods in inland streams, and activity of the adults began about ten days after flooding and lasted 10–14 days. This Simuliid is predominantly associated with *Melaleuca* spp. in the stream beds; the larvae and pupae attach to the submerged branches and fronds and the adults congregate in the exposed parts of the trees. The eggs have not been found. Possible methods of control are briefly discussed from the literature. At present, little is done other than to use smudge fires to protect man and horses, but these are very effective within their limits as the flies are extremely sensitive to acrid smoke.

LEE (D. J.). **Australasian Ceratopogonidae (Diptera, Nematocera). Part I. Relation to Disease, Biology, general Characters and generic Classification of the Family, with a Note on the Genus *Ceratopogon*.**—*Proc. Linn. Soc. N.S.W.* **72** pt. 5–6 pp. 313–331, 23 figs., 37 refs. Sydney, 1948. **Part II. The *Leptocnops* Group of Genera.**—*T.c.* pp. 332–338, 1 pl., 13 figs. **Part III. The *Bezzia* Group of Genera.**—*T.c.* pp. 339–344, 1 pl., 8 figs. **Part IV. The *Stilobezzia* Group of Genera.**—*T.c.* pp. 345–356, 1 pl., 23 figs. **Part V. The *Palpomyia* Group of Genera.**—*Op. cit.* **73** pt. 1–2 pp. 57–70, 1 pl., 20 figs. 1948.

In the first of these papers, the literature on the transmission of filarial worms (*Onchocerca cervicalis* in horses, *O. gibsoni* in cattle and *Filaria (Acanthocheiloneima) perstans* and *F. (Mansonella) ozzardi* in man) by Ceratopogonids of the genus *Culicoides* is briefly reviewed [cf. *R.A.E.*, **B** **16** 155; **22** 58, 251; **28** 105], and reference is made to the possibility of Ceratopogonids being vectors of ephemeral fever in cattle in Australia [**29** 189] and to the annoyance caused to man and domestic animals by their bites where they are abundant. As the

preliminary work on ephemeral fever had shown how little was known of the Australian Ceratopogonids, studies of their taxonomy were begun in 1936 and resumed in 1946 after being broken off for many years. The preliminary results are given in this series of papers, the first of which also contains general notes on characters and habits and previous Australian systematic work, and a table for the differentiation of ten groups of genera on characters of the larvae, pupae and male genitalia, based with slight modification on the classification of Macfie [28 176]. The distinguishing features of each group are given, a key is included to the genera known to occur in the Australasian region, and there are brief notes on the genus *Ceratopogon*, records of which from the region are considered incorrect.

Four of the groups are dealt with in the four subsequent parts, check lists being given of the Australasian species, many of which are described as new, together with notes on the distinctive characters and distribution of most of them and on generic characters. Keys to the Australasian species are included and also translations of the original descriptions of some. It is thought probable that all species of the *Leptoconops* group bite man and those of the *Palpomyia* group are predacious on insects.

WHARTON (G. W.). **The Vectors of Tsutsugamushi Disease.**—*Proc. ent. Soc. Wash.* **48** no. 7 pp. 171–178, 2 figs., 20 refs. Washington, D.C., 1946.

A study of specimens of most of the numerous species of Trombiculids recognised from areas where tsutsugamushi disease is endemic showed that the few species known to transmit the disease are closely related. Nagayo et al. [*R.A.E.*, **B** 10 107] pointed out that there were five species in north-western Japan commonly known as tsutsugamushi. They considered them to belong to a tsutsugamushi group, which they did not, however, define. Walch subsequently described *Trombicula deliensis* [11 134] and *T. keukenschrijveri* [12 151; 13 153] and stated that they belonged to this group. The present author defines the tsutsugamushi group of *Trombicula* and states that the only species that can be definitely included in it are *T. akamushi*, Brumpt, *T. pallida*, Nagayo et al., *T. scutellaris*, Nagayo et al., and *T. intermedia*, Nagayo [which were in the original group of Nagayo et al.] and *T. deliensis*, Walch, *T. fletcheri*, Womersley & Heaslip [which Womersley now considers a synonym of *T. akamushi* [34 144]], *T. obscura*, Womersley (from New Guinea), and *T. fulleri* Ewing (from Burma), which have been described since their paper was published. The literature on the tendency or otherwise of these species to attack man and their relation to tsutsugamushi disease is reviewed. All except the last two have been shown to transmit the disease or to contain the rickettsiae, whereas the rickettsiae have not been recovered from any other mites, including *T. palpalis*, Nagayo et al., the only species of the original group that does not belong to the group as here defined. The evidence that other Trombiculids transmit the disease is examined and considered insufficient. Various other species are closely related to the tsutsugamushi group, and one (*T. keukenschrijveri*) may be found to belong to it, but there is no evidence that they transmit the disease.

It is pointed out that no vertebrate has been proved to serve as a reservoir of tsutsugamushi disease. It has not been demonstrated that a larval mite can become infected by biting a host that harbours the rickettsia, whereas larvae can transmit the disease the first time they feed and rickettsiae have been obtained from adults [*cf.* 34 146; 37 92]. It is suggested that perhaps the free-living nymphs and adults pick up the rickettsiae and that the infected vertebrates cannot pass them to the larvae or are unnecessary for their maintenance. However, evidence points to Cricetine and Murine rodents as the main reservoirs [*cf.* 34 146–147; 35 164, etc.].

FAY (R. W.), COLE (E. L.) & BUCKNER (A. J.). **Comparative residual Effectiveness of organic Insecticides against House Flies and Malaria Mosquitoes.**—*J. econ. Ent.* **40** no. 5 pp. 635–640, 3 figs., 2 refs. Menasha, Wis., 1947.  
**Erratum.**—*T. c.* no. 6 p. 909.

The following is based mainly on the authors' summary. Deposits of 2,2-bis (parachlorophenyl)-1,1-dichlorethane (DDD), chlordane, toxaphene, DDT and di-2(ethylhexyl)phthalate were tested against adults of *Anopheles quadrimaculatus*, Say, and *Musca domestica*, L., and of benzene hexachloride (BHC) against *A. quadrimaculatus*. The phthalate was applied as an emulsion and the other chemicals in solutions or emulsified solutions, test insects were exposed to the deposits in specially constructed chambers for definite periods at specified times after the application of the spray, and mortality after 24 hours was taken as the index of effectiveness. The various substances were applied at 100 or 200 mg. insecticide per sq. ft. The order of decreasing effectiveness over a period of 26 weeks was DDT, BHC, chlordane, toxaphene and DDD. The di-2(ethylhexyl)phthalate showed no lasting effectiveness. Loss of toxicity of most materials was gradual against mosquitos and sudden against house-flies. The duration of effectiveness of water-wettable DDT powder suspensions from different commercial sources varied considerably over a period of 36 weeks. Two DDT-isomer by-product concentrates had low initial effectiveness, but excellent toxicity later.

Tests were also made of deposits from sprays of pyrethrins with piperonyl cyclohexenone against mosquitos and house-flies and of pyrethrins with piperonyl butoxide against house-flies; these are the only ones about which corrections are made in the supplementary note. Both had little lasting effect when the sprays were applied at the strength recommended by the manufacturers for space spraying, but a deposit of 10 mg. pyrethrins with 200 mg. piperonyl cyclohexenone per sq. ft. gave good mortality of *A. quadrimaculatus* for 23 weeks.

BLAKESLEE (E. B.), TISSOT (A. N.), BRUCE (W. G.) & SANDERS (D. A.). **DDT to control the Gulf Coast Tick.**—*J. econ. Ent.* **40** no. 5 pp. 664–666, 1 ref. Menasha, Wis., 1947.

A large herd of cattle at St. Augustine, Florida, was treated in July 1945 with a spray containing 2.5 per cent. DDT for the control of horn flies [*Siphona irritans*, L.], and 150 of the animals were then placed in a pasture supposed to be heavily infested with *Amblyomma maculatum*, Koch. The ears of 50 of these were treated with a smear containing 5 per cent. DDT [*cf. R.A.E.*, B **32** 200; **35** 92] and the remainder served as controls. Of 251 ticks of both sexes found on the control animals during the season, only 26 females started to engorge, and only three replete ones were found. Two replete females were found on the animals with treated ears. This suggested that spraying with DDT might replace the use of ear treatments, which are slow and laborious to apply and expose stockmen and animals to more or less danger of injury.

In 1946, a spray containing 2.3 per cent. water-dispersible DDT applied on 13th August and 5th September at 21 and 26 gm. technical DDT per animal consistently gave control equal to that effected by one application in August of a smear containing 5 or 7.5 per cent. DDT at 4 or 3.6 gm. DDT per head, respectively. Both applications of spray were heavier than was necessary, and it is doubtful whether the second materially affected the results. At a test at Indiantown, one lot of cattle received an ear treatment of 7.5 per cent. DDT at about 2.5 gm. DDT per animal, another received one of 5 per cent. DDT at about 2 gm. per animal, a third was sprayed once with 2.3 per cent. DDT spray at about 13 gm. per animal and a fourth was untreated. The results confirmed those at St. Augustine, control of ticks on the sprayed cattle being

quite equal to that on cattle that received ear treatment. Only one case of infestation by screw-worms [*Callitroga hominivorax*, Coq.], to which animals are predisposed by *A. maculatum*, developed by 30th September in a herd sprayed on 4th September with a 2.3 per cent. DDT spray at 11 gm. DDT per animal. It is concluded that a full-coverage DDT spray will control *A. maculatum* as effectively as the best ear smears so far developed. A lower concentration than those used might be effective. The number of applications necessary in a full season has not been determined, but it is not likely to be more than for ear treatments. The sprays have the advantage of controlling other blood-sucking Arthropods.

FURMAN (D. P.). **Benzene Hexachloride to control Cattle Lice.**—*J. econ. Ent.* **40** no. 5 pp. 672–675, 4 refs. Menasha, Wis., 1947.

Infestations of *Haematopinus eurysternus*, Nitzsch, and *Linognathus vituli*, L., on cattle in California were eradicated in the winter of 1946–47 by dipping once in a suspension containing 0.3 per cent. benzene hexachloride (equivalent to about 0.036 per cent.  $\gamma$  isomer) [cf. *R.A.E.*, B **37** 90]; a dip containing half as much eliminated *Damalinia (Bovicola) bovis*, L., but was not tested against the other species. The results of the dipping tests, together with preliminary spraying tests, showed that toxicity was manifested by complete kill of all motile stages, a fairly high kill of eggs [cf. **36** 89–90] and failure of any young that hatched to survive on a treated animal. If this last effect was due to residual action, heavy rains shortly after treatment might prevent complete control being obtained. It is pointed out that percentage hatch was greater in eggs left on the cattle for several days than on those removed after one hour, presumably because of greater aeration. A prepared suspension of benzene hexachloride was shown to retain its effectiveness in a field vat for at least 38 days.

SUN (Yun-Pei) & SHEPARD (H. H.). **Methods of calculating and correcting the Mortality of Insects.**—*J. econ. Ent.* **40** no. 5 pp. 710–715, 5 refs. Menasha, Wis., 1947.

In this paper, which is noticed in more detail elsewhere [*R.A.E.*, A **37** 250], a modification of Abbott's formula [A **13** 331] for estimating the percentage mortality of an insect given by an insecticide is suggested. The modified formula, which makes allowances for a natural increase in the population, as well as for natural mortality, is  $100 (Pt \pm Pc) \div (100 \pm Pc)$ , where  $Pt$  is the percentage of apparent mortality of the treated insects and  $Pc$  is the percentage change in population of the controls (untreated insects); the sign will be positive when the population of the untreated insects has increased and negative when it has decreased.

FREAR (D. E. H.) & SEIFERLE (E. J.). **Chemical Structure and insecticidal Efficiency.**—*J. econ. Ent.* **40** no. 5 pp. 736–741, 2 refs. Menasha, Wis., 1947.

The information in this paper, which is noticed in more detail elsewhere [*R.A.E.*, A **37** 254], is based on published and unpublished results of tests of over 6,000 chemical compounds as insecticides. Tables are given showing the chemical groups contained in these compounds, the numbers of compounds that contained them, the numbers of tests with the latter, and the percentages of these tests in which insecticidal action was observed; the extent to which the various groups are associated with toxicity is discussed.

WIRTH (W. W.). **Notes on the Mosquitoes of Louisiana.**—*J. econ. Ent.* **40** no. 5 pp. 742-744, 7 refs. Menasha, Wis., 1947.

Details are given of light-trap collections of some 13,000 mosquitos made in five parishes in Louisiana between July 1942 and April 1943, together with data on the seasonal occurrence of 44 of the 49 species known from the State, based on collections made in 1941-47. They included six species of *Anopheles*. These were *A. quadrimaculatus*, Say, and *A. punctipennis*, Say, which were taken in every month except February and December, respectively, *A. barberi*, Coq., taken from March to October, *A. crucians*, Wied., which was taken in every month [cf. *R.A.E.*, B **33** 68], *A. pseudopunctipennis*, Theo., a single female of which was taken in a light-trap in October 1942 and *A. walkeri*, Theo., which is rare in the State, though numerous adults and larvae were taken from fresh-water marshes near Lake Charles in May and June 1943 and there are records for April and August-November. Notes are given on other rare or unusual species found, and a list of the five species, including *A. atropos*, D. & K., not taken by the writer but known to occur in Louisiana.

DU CHANOIS (F. R.). **Toxicity of Gamma-Benzene Hexachloride to preimaginal Stages of the Housefly.**—*J. econ. Ent.* **40** no. 5 pp. 749-751, 9 refs. Menasha, Wis., 1947.

The toxicity of the  $\gamma$  isomer of BHC (benzene hexachloride) to eggs of *Musca domestica*, L., 1-4 hours old, second-instar larvae 2-3 days old, third-instar larvae 4-5 days old, and pupae 1-2 days old was tested by placing them on or between two disks of paper towelling cut to fit 50 ml. stender dishes and adding a measured quantity of the test substance (technical BHC in the preliminary tests and pure  $\gamma$  isomer in final tests). The covers of the dishes conserved moisture and permitted some ventilation as evidenced by low mortality in control dishes. In less extensive tests,  $\gamma$  BHC was incorporated in an artificial medium of whole crimped oats, lucerne meal, barley malt, fresh yeast and tap water and in finely-milled softwood sawdust. The latter proved to be a convenient, practically non-toxic substratum for testing the insecticide. The culture medium also provided a larval nutriment and substratum for oviposition in rearing the experimental colonies. The main results are given in a table. The BHC was practically non-toxic to eggs even at 4-8 gm.  $\gamma$  isomer per 100 ml., but there was rapid post-incubation poisoning. The dosages per litre of pure  $\gamma$  isomer required for 50 and 95 per cent. mortality of the other stages in tests in glass-covered dishes were 3.21 and 13.5 mg. for second-instar larvae, 18.54 and 83.8 mg. for third-instar larvae, and 618 and 17,900 mg. for pupae, respectively. Young larvae were nearly all killed within 24 hours. Some repellent action against larvae was observed. In the medium and in sawdust, 4.52 and 6.86 mg. per litre, respectively, were required for 50 per cent. mortality of third-instar larvae and 15.3 and 23.6 mg. for 95 per cent. mortality. It is concluded that  $\gamma$  BHC is a potentially practical field larvicide for *M. domestica*. The results indicate that even the comparatively resistant pupae might be controlled at practical dosages.

FALES (J. H.), MCGOVAN (E. R.) & FULTON (R. A.). **Gamma-Benzene Hexachloride in the liquefied-Gas Aerosol.**—*J. econ. Ent.* **40** no. 5 p. 754, 2 refs. Menasha, Wis., 1947.

Commercially prepared pure  $\gamma$  BHC (benzene hexachloride) was tried as a substitute for DDT in aerosols in two series of tests made in a Peet-Grady chamber against *Musca domestica*, L., and *Anopheles quadrimaculatus*, Say. The exposure period was 15 minutes, and mortality counts were made after

one day. In the first series, a formula containing 0.4 per cent. pyrethrins, 3 per cent. DDT and 17 per cent. diisopropylnaphthalene (K-294) was compared with one containing 2 per cent.  $\gamma$  BHC and 15 per cent. diisopropylnaphthalene. The propellant gas was dichlorodifluoromethane in both cases. At equal dosages of 0.4 gm. aerosol solution per 1,000 cu. ft., the aerosols containing DDT and BHC gave 59 and 70 per cent. kill of house-flies and 74 and 89 per cent. kill of female mosquitos, respectively. Knockdown was quicker with BHC.

In the second series of tests, 0.4 per cent. pyrethrins, 3 per cent. DDT, 5 per cent. cyclohexanone and 5 per cent. lubricating oil and the same formula with  $\gamma$  BHC substituted for the DDT gave 58 and 80 per cent. kill, respectively, of house-flies at similar dosages (0.42 and 0.43 gm. per 1,000 cu. ft.), 74 and 96 per cent. kill of female mosquitos and 74 and 98 per cent. of males. Knockdown of flies after 15 minutes was 21 per cent. with DDT and 49 per cent. with BHC. The knockdown of mosquitos was also markedly greater with BHC. The  $\gamma$  BHC caused no corrosion of metal in the standard aerosol corrosion test.

HANSENS (E. J.). **Small Dispensers for larviciding in Mosquito Control.**—*J. econ. Ent.* **40** no. 5 p. 755. Menasha, Wis., 1947.

Satisfactory application of mosquito larvicides consisting of DDT and a spreader in oil has been made in New Jersey by the use of a small dispenser (Eagle Force Oiler) with a capacity of about 100 ml., ejecting about 1 ml. oil per stroke for 20–30 ft. For larger areas, the capacity of the oiler can be increased by joining it with rubber tubing to a can holding 1 U.S. gal. The can is then carried on the back, and several acres can be treated. The best results were obtained with a mixture of 1.5 per cent. DDT and 0.5 per cent. B1956 emulsifier [a phthalic glyceryl alkylid resin] in No. 2 fuel oil applied at 1 ml. per 50, 100 and 200 sq. ft. ( $\frac{1}{2}$ , 1 and 2 U.S. pints per acre). All these dosages gave complete kill of larvae. It occurred within 24 hours with the highest dosage, but 72 hours were sometimes needed with the lowest. These small applications did not have any residual effect or kill pupae, but they were too small to affect aquatic life adversely even if an overdose was applied.

HORSFALL (W. R.) & PORTER (D. A.). **Biologies of two Malaria Mosquitoes in New Guinea.**—*Ann. ent. Soc. Amer.* **39** no. 4 pp. 549–560, 4 figs., 11 refs. Columbus, Ohio, 1947.

*Anopheles punctulatus*, Dön., and *A. farauti*, Lav., are the principal vectors of malaria in New Guinea and adjacent islands [cf. *R.A.E.*, B **34** 122] and possible vectors of filariasis [caused by *Filaria (Wuchereria) bancrofti*] in parts of these areas [cf. **37** 10, etc.]. An account is given of observations on their bionomics, made during 1943 and 1944 in eastern and northern Papua and on Biak in the Schouten Group. *A. punctulatus* was most abundant on heavy clay soil, whether at sea level or inland, and was reported to occur as high as 3,500 ft. in the mountains. *A. farauti* was present on the coastal plains where the soil was sand or mud, and both species occurred where the soils intergraded. Larvae of both developed largely in sunlit ground pools, *A. punctulatus* mainly in depressions such as tracks of all sorts [**35** 162; **36** 136], especially in clearings incident to construction of army camps, and *A. farauti* in natural pools, particularly those with floating sticks or vegetation [**37** 52], and grassy margins of sluggish streams [**36** 84]. *A. farauti* also bred in partly shaded sections of mangrove swamps subject to only slight tidal fluctuation [cf. **36** 135] particularly if floatage was abundant.

*A. punctulatus* required on the average one day less than *A. farauti* for the egg stage and each larval instar. The mean durations in days of the egg,

larval and pupal stages in the laboratory were 2.5, 7.5 and 1 for *A. punctulatus* and 3.5, 11.3 and 1.2 for *A. farauti*. In the field, under very favourable conditions in sunlit sites, the former may complete larval and pupal periods in five or six days. Applications of larvicides must therefore be repeated every five days to ensure its control, but once a week was adequate where only *A. farauti* was present.

Eggs of both species may be deposited on moist surfaces or on water. Those on moist surfaces incubated at the normal rate but did not hatch until floated; they remain viable for 14 days. Larvae of *A. punctulatus* were very active but those of *A. farauti* moved little except when disturbed. Adults of both species were collected on moist banks near villages. *A. punctulatus* was most commonly taken on vertical banks out of direct sunlight within a few feet of a frequently used trail or place where natives sat on the ground to work. The limit of effective flight-range of *A. punctulatus* was determined, by elimination of larvae by oiling in a native area near Oro Bay, to be  $\frac{3}{4}$  mile. Females at a collecting site at this distance from the untreated area were reduced by about 97 per cent. The population returned to normal within six weeks.

Dissection of 414 females of *A. punctulatus* that had probably fed only once in the wild in an area where malaria was prevalent showed oöcysts in 20 and sporozoites in three. Of 132 females of *A. farauti* examined, five contained oöcysts and none sporozoites. Unidentified filarial larvae presumed to be *Filaria (Wuchereria)* sp. were found in 3.8 per cent. of *A. punctulatus* and 2.3 per cent. of *A. farauti*.

RANDOLPH (N. M.) & EADS (R. B.). **An ectoparasitic Survey of Mammals from Lavaca County, Texas.**—*Ann. ent. Soc. Amer.* **39** no. 4 pp. 597–601, 10 refs. Columbus, Ohio, 1947.

In view of the prevalence of murine typhus in southern Texas, an extensive programme of research on the disease has been carried out in Lavaca County since January 1945. It has included a survey of ectoparasites of mammals, and a list is here given of species examined and of the species of insects, mites or ticks found on them. All but one of the insects recorded were fleas or lice.

FORBES (J.) & HORSFALL (W. R.). **Biology of a Pest Mosquito common in New Guinea.**—*Ann. ent. Soc. Amer.* **39** no. 4 pp. 602–606, 2 refs. Columbus, Ohio, 1947.

*Aedes scutellaris scutellaris*, Wlk., is one of the most annoying pest mosquitos in New Guinea and adjacent islands, where it is widely distributed. It is a sylvan species that is adaptable to domestic conditions. Small amounts of water in plant parts and in artificial containers are usual breeding places [*R.A.E.*, B **36** 175], and larvae were produced in large numbers in exposed supply and salvage dumps about army camps and once in bilge water in amphibious aircraft. Cartons contained a greater average number of larvae than metal containers, which varied in suitability. Those with lacquer linings were preferred to those without. Metal containers that had been blackened by burning were decidedly less attractive than others. Eggs were sometimes laid in a meniscus about emergent or floating objects or on moist surfaces above water level. Adults tended to remain near breeding-places. Marked females were collected 500 yards from the point of release, but it was observed in two different areas that females did not travel 800 yards in sufficient numbers to cause annoyance. Moderate breezes did not prevent feeding, but strong ones kept the mosquitos from coming out.

The egg, larval and pupal stages occupied averages of 5, 5.2 and 2 days, respectively. The egg stage varied from 2 to 21 days when the eggs were kept

in water continuously. One batch hatched in the laboratory after being kept for 61 days in a moist chamber before submersion. For eggs to remain viable for so long they must first have incubated on a wet surface long enough for the embryo to develop to the hatching stage. Some adults lived six weeks in the laboratory. The mean length of life of 33 females that had an opportunity to feed daily was 21.9 days. Pairing usually took place on the first or second day after emergence. The preoviposition period was about seven days but extended to 25 days in one case. Several batches of eggs may be laid by one female, and the mean number of eggs for caged females was 86.

**Present Status of Repellent "448".**—*Soap & sanit. Chem.* **22** no. 11 pp. 116–117. New York, N.Y., 1946.

A mixture of 30 per cent. (by volume) 2-cyclohexyl-cyclohexanol and 70 per cent. 2-phenyl-cyclohexanol (designated NMRI 448) was found by workers at the United States Naval Medical Research Institute under the direction of M. Pijoan and L. A. Jachowski to be a particularly effective repellent against several species of mosquitos in tropical areas. The application of four drops to the face or neck, four to each arm and six to each leg gave complete protection for average periods of 5–10 hours against various species of *Aedes*, 9–11 against species of *Anopheles*, 12 against bed-bugs [*Cimex*], 4 against "sandflies" and 8 against chigger mites [Trombiculids]. Most of the tests were interrupted. NMRI 448 tends to solidify at about 74°F., which would affect its use in the temperate zone, but a solution of ethyl alcohol containing 80–85 per cent. NMRI 448 had a crystallisation temperature of between –3 and 4°C. [26.6 and 39.2°F.] and gave protection for 310–340 minutes. Mice that received 15 mg. NMRI 448 daily showed no ill effects after three months of such feeding, and though the repellent failed to satisfy skin sensitisation tests at one laboratory, at another it produced no reaction when applied to the arms twice daily for three months, and over 100,000 2 oz. bottles were distributed commercially with very few complaints of erythema and none of dermatitis. It should not be applied too close to the eyes or mucous membranes. In limited field tests, mixtures containing 60 per cent. NMRI 448 gave protection for only about 40–50 per cent. as long as ethylhexanediol against *Aedes sollicitans*, Wlk., and about 80 per cent. as long against *A. aegypti*, L.

In standard Peet-Grady tests [against *Musca domestica*, L.], oil sprays containing 1 and 25 per cent. NMRI 448 gave 33.9 and 96.1 per cent. knock-down in ten minutes and 16.6 and 77.1 per cent. kill, respectively.

DEONIER (C. C.), JONES (H. A.), HALLER (H. L.), HINCHEY (E.) & INCHO (H. H.).—**Mosquito Larvicide Tests. A Résumé of Tests of Compounds related to DDT against Larvae of *Anopheles quadrimaculatus*.**—*Soap & sanit. Chem.* **22** no. 11 pp. 118–119, 139, 8 refs. New York, N.Y., 1946.

Records are given of tests against larvae of *Anopheles quadrimaculatus*, Say, of 73 compounds chemically related to DDT. Some bear a close structural relation to DDT and others are related to it only in a portion of their structure. Initial tests were made at a concentration of 10 parts per million, and compounds that gave over 50 per cent. mortality in 48 hours at this concentration were tested successively at 1, 0.1, 0.05, 0.025, 0.01, 0.005 and 0.0025 p.p.m. The most toxic compounds were 1,1-dichlor-2,2-bis(p-chlorophenyl)ethane [DDD] and 1,1,1-trichlor-2,2-bis(p-bromophenyl)ethane, both of which gave 95 per cent. kill in 48 hours at 0.0025 p.p.m. while pure DDT in corresponding tests gave 82 and 80 per cent. kill, respectively. The o,p' forms of DDT and DDD, though considerably less toxic than p,p' compounds, were about as toxic as each other, both having a minimum toxic concentration of 0.025 p.p.m. In

general, highly toxic compounds were closely related analogues of DDT, though some closely related compounds, including 1,1-dichlor-2,2-bis(p-chlorophenyl)ethylene and 1,1,1-tribromo-2,2-bis(p-bromophenyl)ethane, were of a low order of toxicity.

All the compounds toxic at 0.025 p.p.m. or less had either a  $\text{CH.CCl}_3$  or a  $\text{CH.CHCl}_2$  group. Some compounds without halogen on the benzene ring had a rather high degree of effectiveness. These included 1,1,1-trichlor-2,2-bis(p-methoxyphenyl)ethane [methoxy-DDT] and 1,1,1-trichlor-2,2-di-p-tolylethane. However, 1,1,1-trichlor-2,2-diphenylethane, with no substituents on the benzene ring, was of a low order of toxicity.

HENDERSON (L. S.). **DDT for Control of Roaches.**—*Soap & sanit. Chem.* **22** no. 11 pp. 121–123, 143. New York, N.Y., 1946.

Initial tests of DDT for the control of cockroaches indicated that it was satisfactory against the American cockroach [*Periplaneta americana*, L.] but not against the German cockroach [*Blattella germanica*, L.]. However, in later work, good control of all species infesting houses in the United States was obtained [cf. *R.A.E.*, B **35** 91, etc.]. Notes are given on the action of DDT on cockroaches and the precautions to be taken in using it, and methods of applying it are described, particularly for the control of *B. germanica*, which usually lives and develops in the immediate area where it is troublesome. The DDT may be used as a 10 per cent. dust spread in a thin film over the floor, tables, etc., as a temporary measure or permanently in crevices, behind and beneath splash and draining boards, round pipes, in and behind cupboards, etc.; as a 5 per cent. solution in deodorised kerosene in exposed places where dust would be unsightly, and on vertical surfaces and the underside of tables and shelves; as a 5 per cent. emulsified solution in places where there is risk of fire or the temporary oil film left by unemulsified solutions would be undesirable; or as a 1 or 2 per cent. suspension in water in places where the visible white deposit is of no consequence. Reference is also made to the addition of 0.5–3 per cent. DDT to fly-sprays and of small amounts to aerosols, but applied in this way it acts by direct contact only and is not generally recommended. *P. americana* often develops in large numbers in a warm damp basement or storeroom from which the infestation spreads up the building. Control measures should be applied at the source, and as this is often a damp place, a spray is generally better than a dust. Where the deposit of the suspension will not be objectionable, this may be the best form to use. The oriental cockroach [*Blatta orientalis*, L.] is even more limited to damp areas than *P. americana* and the same methods of control should be used. The brown-banded cockroach [*Supella supellectilium*, Serv.] is becoming increasingly prevalent in the United States. It occurs all over the house, living in high places, such as the upper parts of cupboards or bookshelves, in desks and cabinets, on upholstered furniture, and on the undersides of tables and chairs. The hiding places should be carefully sought out and treated with a combination of dust and spray, the dust being blown into cracks and underneath and behind furniture and the spray applied, with a brush if necessary, to undersurfaces and vertical surfaces and in exposed places.

JONES (H. A.), TITUS (H. A.) & OBERG (M. W.). **DDT Emulsion Concentrates.**—*Soap & sanit. Chem.* **22** no. 12 pp. 155, 157, 165, 4 refs. New York, N.Y., 1946.

As xylene, the solvent in the all-purpose DDT emulsion concentrate developed for use by the U.S. armed forces [*R.A.E.*, B **36** 86], has a flash-point too low for safety in shipping and allows the DDT to separate from the concentrate on standing at low temperatures, several modified formulae were developed.

A minimum of 110°F. was adopted for the flash-point, though a higher one was desirable. In order that kill of insects by deposits should be satisfactory, the boiling range should not be higher than that of kerosene [*cf.* 35 90]. Suggested formulae comprised 25 per cent. technical DDT, 15 per cent. Triton X-100 and 60 per cent. solvent. A list is given of 17 that were tested, showing the flash-point, the degree of separation of DDT from concentrate after three months at about -5°C. [23°F.], and the approximate stability of emulsions containing 1 per cent. DDT formed from it in distilled water, hard water and sea water. Where emulsification in sea water is not required, less emulsifier may be used.

The following is taken from the authors' summary. Solvent mixtures comprising cyclohexanone or isophorone, as auxiliary solvents, with aromatic petroleum fractions such as PD-544-C and Solvesso No. 3, with coal-tar fractions such as the Hi-Flash solvents, or with solvents such as tetrahydronaphthalene, gave concentrates that fulfilled all requirements, including retention of DDT on storage at slightly below 0°C. [32°F.]. Aromatic petroleum fractions such as PD-544-C and Velsicol AR-41 (chiefly methyl- and polymethylnaphthalenes), and a coal-tar fraction such as Cumene fraction, when used without auxiliary solvents, gave concentrates that were satisfactory provided storage was at temperatures somewhat above 0°C. Other satisfactory solvents or combinations of solvents are available. Emulsions made from concentrates of the type suggested gave satisfactory results as mosquito larvicides and as sprays to leave a toxic residue against mosquitos and houseflies [*Musca domestica*, L.].

WILLIAMS (R. W.) & BROWN (H. W.). **The Development of *Litomosoides carinii*, Filariid Parasite of the Cotton Rat, in the Tropical Rat Mite.**—*Science* 102 no. 2654 pp. 482-483. Lancaster, Pa., 1945. **The Transmission of *Litomosoides carinii*, Filariid Parasite of the Cotton Rat, by the Tropical Rat Mite, *Liponyssus bacoti*.**—*Op. cit.* 103 no. 2669 p. 224, 2 refs. 1946.

It is recorded in the first paper that *Litomosoides carinii*, a parasite of the cotton rat (*Sigmodon hispidus*), was found to develop to the infective stage in *Liponyssus bacoti*, Hirst. The forms observed in the mite are described. No developing filariae were found in other parasites of the cotton rats, including fleas, lice and ticks, and no development of the microfilariae took place in *Cimex lectularius*, L., *Mansonia perturbans*, Wlk., or four species of *Aedes*. Three species of *Culicoides* failed to feed on the rats.

It is stated in the second that when two white rats in cages were placed separately in boxes each containing an infected cotton rat in a similar cage with a colony of *L. bacoti* developing on it and the positions of the cages were periodically interchanged so that the mites from the cotton rats had easy access to the white rats, both the latter were found to be infected in the pleural cavity on autopsy, after 42 and 44 days. The forms found in them and in the mites are described. In similar circumstances but in the absence of mites, white rats did not become infected. In a further test, a cotton rat and white rat, experimentally infected by the mite, exhibited microfilariae in their blood 80 days after exposure. Epidemiological evidence indicated that naturally infected rats might show microfilariae as early as 50-60 days after exposure to infection.

WILLIAMS (R. W.). **The laboratory Rearing of the Tropical Rat Mite, *Liponyssus bacoti* (Hirst).**—*J. Parasit.* 32 no. 3 pp. 252-256, 4 figs., 5 refs. Lancaster, Pa., 1946.

Since sufficiently large numbers of *Liponyssus bacoti*, Hirst, for experiments on the transmission of *Litomosoides carinii* to cotton rats (*Sigmodon hispidus*)

or white rats [see preceding abstract] cannot easily be collected in nature, a method of rearing the mite in the laboratory was developed. The original mites were collected from fine wood-shavings placed under cages in which field-caught rodents were confined, but they can also be taken directly from rodent nests. *Liponyssus bacoti* has a wide distribution in the United States and has been recorded from rats, mice, guineapigs and squirrels. For rearing large colonies, artificial nests resembling rat nests were constructed by depositing half an inch of loam soil on several layers of newspaper in the bottom of a box, with straw placed over it and bunched against the sides of the box. Cotton rats in small cages made from half-inch mesh galvanised wire were placed in the straw, and the mites placed on the animals. Straw was found to be superior to grass or wood shavings, and soil to sand. Urine was kept at a minimum by giving the animals water in their food supply only. Strips of water-soaked sweet potato were very satisfactory. The best results were obtained at a relative humidity of 85-90 per cent., with a minimum of 70 per cent. To prevent the escape of the mites, the upper edges of the boxes were ringed with vaseline and the boxes were kept on trays surrounded by troughs filled with oil. A colony started in this way with 32 mites on two rats increased in two weeks to at least 1,000 mites. If the mites are not utilised there is a danger of the hosts dying of anaemia [*cf. R.A.E.*, B 35 171]. Fresh hosts should therefore be substituted from time to time or the colony allowed to decrease by starvation.

Observations on mites placed in glass vials soon after feeding and kept at a room temperature of about 21°C. [69-8°F.] and an unknown humidity indicated that females laid an average of rather more than seven eggs after a blood-meal, at intervals of 3-5 hours, and that a further blood-meal was required before more could be laid. The eggs hatched in 38.5-53.5 hours, and the larvae moulted after 19-24 hours, without feeding [*cf. loc. cit.*]. Females were thought to feed about every other day and to oviposit after each blood-meal.

PRATT (I.) & NEWTON (W. L.). **The Migration of infective Larvae of *Wuchereria bancrofti* within the Mosquito Host and their Rate of Escape under laboratory Conditions.**—*J. Parasit.* 32 no. 3 pp. 272-280, 2 graphs, 7 refs. Lancaster, Pa., 1946.

A detailed account is given of laboratory studies undertaken to provide quantitative data on the migrations of larvae of *Filaria (Wuchereria) bancrofti* within their mosquito host and their eventual escape from it [*cf. R.A.E.*, B 35 160]. The following is based on the authors' summary and conclusions. Females of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) that had fed on a volunteer showing microfilariae of the periodic strain of *F. bancrofti* in the peripheral blood were kept in screened cages with a constant supply of cotton-wool soaked with sugar solution. Dissections were made every two days from 16½ to 30½ days after infection, usually at the rate of 26 mosquitos for every time interval, and a few individuals were examined 39½ days after infection. In all, 209 dissections were made. The numbers of larvae of *Filaria* found in the head, proboscis, thorax and abdomen were recorded in each case. A comparison of the counts for the various sites with one another and with the total counts showed that, after they reached the infective stage, the larvae left the thorax in which they had developed, and though a few migrated directly to the head and proboscis, the majority went to the abdomen first. They apparently stayed there for only a short time and then migrated forward to the head and proboscis.

The data indicated that the larvae left the mosquitos in considerable numbers after 18½ days of infection. It was assumed that they did so through the proboscis since many were seen to emerge from the proboscis when the tip

of the latter was dipped into saline, some mosquitos had a ruptured proboscis prior to dissection, and larvae were never seen to leave any other part of the body [cf. 16 67; 30 17; 31 10]. After most of the larvae had left the mosquito, 24½ days after infection, the remainder seemed to migrate back and forth from abdomen to head, with a few leaving the proboscis occasionally. However, the numbers of larvae were so small by that time that no accurate conclusions could be drawn. It is considered that the larvae escaped from the mosquito while it was feeding on sugar-water or when the proboscis became ruptured, probably as a result of its being too tightly packed with larvae [31 10]. Loss of larvae resulting from these causes could be expected during the week following the attainment of the infective stage under natural conditions.

WHARTON (G. W.) & HARDCASTLE (A. B.). **The Genus *Neoschöngastia* (Acarinida : Trombiculidae) in the Western Pacific Area.**—*J. Parasit.* 32 no. 3 pp. 286–322, 15 figs., 16 refs. Lancaster, Pa., 1946.

The type of *Neoschöngastia* Ewing (1929) is *Schöngastia americana*, Hirst. Womersley (1939) erected the genus *Paraschöngastia* for the species of *Neoschöngastia* that have a ridge on the scutum anterior to the pseudostigmata, and Womersley and Heaslip (1943) designated *N. yeomansi*, Gunther, as the type of *Paraschöngastia*. As, however, *N. americana* and *N. yeomansi* are congeneric, *Paraschöngastia* is a synonym of *Neoschöngastia* and a new name is required for the genus *Neoschöngastia* as understood by Womersley. The authors give descriptions of the larva and nymph of *Neoschöngastia*, a key to the larvae of the 17 species of the genus, including 11 new ones, known from the Western Pacific area and a list of these species with information on synonymy, hosts, distribution and the morphology of the larvae (and in two cases of the nymphs also), including a description of a new subspecies of *N. americana*. All the new forms were taken on birds in the course of a survey in 1944–45.

MUSPRATT (J.). **On *Coelomomyces* Fungi causing high Mortality of *Anopheles gambiae* Larvae in Rhodesia.**—*Ann. trop. Med. Parasit.* 40 no. 1 pp. 10–17, 1 pl., 6 refs. Liverpool, 1946. **Experimental Infection of the Larvae of *Anopheles gambiae* (Dipt., Culicidae) with a *Coelomomyces* Fungus.**—*Nature* 158 no. 4006 p. 202, 4 refs. London, 1946.

In the first paper, three types or species (*a*, *b* and *c*) of fungi of the genus *Coelomomyces* found in mosquito larvae at Livingstone, Northern Rhodesia, between March 1941 and May 1945 are described. They are recognised chiefly by differences in their thick-walled resting sporangia. Type *a*, the commonest, occurs chiefly in *A. gambiae*, Giles, and only occasionally in *A. squamosus*, Theo., and *A. rufipes*, Gough. A heavy infection in one larva of *A. rivulorum*, Leeson, collected from pools containing *A. gambiae*, was the only instance of a larva of the *funestus* series being found to contain sporangia. However, one or two larvae of *A. funestus*, Giles, from a batch transported to an infected pool developed weak infections that did not mature. Some larvae of *A. pretoriensis*, Theo., became infected when transported to an infected pool. Larvae of *A. coustani*, Lav., and *A. rhodesiensis*, Theo., collected from the same pools as infected ones of *A. gambiae* showed no sign of infection, nor did mosquito larvae of other genera except for one or two larvae of *Culex simpsoni*, Theo. Type *b*, which is much rarer, was found in larvae of *A. gambiae* and *A. squamosus*, and type *c* in those of *Aedes scatophagoides*, Theo., only. A fourth type (*d*) of thick-walled sporangium was found in the stem of a sedge (*Cyperus*) but not in mosquito larvae.

The infected larvae were in surface-pools in low-lying areas in which the soil was heavy dark-brown loamy clay (locally called "mopane" clay) intermixed with sand. In pools that were under observation over the four years, at least 90 per cent. of larvae that reached the fourth instar were infected and subsequently died (for unless infection is contracted just before pupation, an infected larva can seldom if ever pupate in nature), and the estimated mortality among larvae that hatched in these pools in the rainy season was 95 per cent. [cf. *R.A.E.*, B 33 117]. Larvae may become infected in any stage. An infection contracted very late usually kills the pupa or adult. It is not known whether infection is ever found in surviving adults in nature [cf. 30 183]. When there is regular intermittent rainfall, specks that will become the fungal thalli appear in the body fluid of the larvae of *A. gambiae* about a week after the pool-basins have been filled by rain, provided that dry spells precede and succeed the showers that fill the basins. Under these circumstances, the larvae become infected when 3-4 days old (in the late first or second instar) and large numbers of sporangia are found in those surviving to the third and fourth instars. Under normal conditions in nature, it takes only 2-3 days for the thalli to develop into sporangia, and once these have developed, the larvae are unable to pupate. Larvae of *A. gambiae* containing thalli of type *a* and moved to the laboratory do not develop the heavy infections of sporangia found in those surviving in the natural habitat. It is possible that this is due to reinfestation in nature, as sometimes small undeveloped thalli are intermingled with the sporangia. The author believes, however, that infestation usually appears only for a short time when the pools have reached a certain concentration as a result of evaporation. Infectivity seems to disappear just before the pools dry up.

An experiment is described indicating that the infecting organisms can travel through the soil-water for some distance. In the laboratory, the thin-walled sporangia germinated in water a few days after the death of the larvae, but the thick-walled resting ones germinated only after being incubated dry at 28°C. [82.4°F.] for 2-3 weeks. The technique is given.

The second paper is a record of the experimental infection of larvae of *A. gambiae* with the type *a* fungus. Between 300 and 400 larvae full of thick-walled sporangia were put in jars containing water and soil from the breeding-place in Northern Rhodesia, and when the larvae were dead, the water was allowed to evaporate until the soil was almost dry. The jars were then sent, together with about 100 lb. of the "mopane" clay soil, to Johannesburg. After more than eight months, the soil was put in the centre of a trough, the contents of the jars were scattered on the lower part of the mound, and rain-water and laboratory-bred larvae of *A. gambiae* were added. The trough was kept outdoors, where it was exposed to the sun for 3-4 hours each day. The water was allowed to evaporate every 2-3 weeks, and the trough remained dry for 3-4 days before it was refilled and another batch of newly hatched larvae put in. About 15 out of 100 larvae in the second batch and a few in later batches became heavily infected.

The author suggests that it may be necessary to use rain-water and to allow it to evaporate in the sun to about one-third of its volume to make infection possible. The germination of the resting sporangia may perhaps be regulated by a slight increase in the concentration of the soil mineral salts in solution.

BURT (E.). **Incubation of Tsetse Pupae : increased Transmission-rate of *Trypanosoma rhodesiense* in *Glossina morsitans*.**—*Ann. trop. Med. Parasit.* 40 no. 1 pp. 18-28, 3 figs., 18 refs. Liverpool, 1946. **The Sex Ratio of infected Flies found in Transmission-experiments with *Glossina morsitans* and *Trypanosoma rhodesiense*.**—*T. c.* pp. 74-79, 15 refs.

These two papers concern experiments at Tinde, in Tanganyika, on factors influencing the transmissibility of *Trypanosoma rhodesiense* by *Glossina*

*morsitans* Westw. When transmission to an indicator-animal by a batch of flies (usually about 100) had been obtained, the individual flies were examined for infection by isolating them on white rats. In the first paper, it is recorded that 12.2 per cent. of 3,352 flies from pupae incubated at 30°C. [86°F.] acquired infection from an infected animal, while only 4.2 per cent. of 7,127 flies from pupae left under normal laboratory conditions did so. Lower infection rates (11.6 and 3.2 per cent., respectively) were obtained when results from dissection were included, indicating that many infected flies were not detected by this means. Transmission occurred in all of the 110 experiments in which flies from incubated pupae were fed on animals with trypanosomes in their blood and then on susceptible animals, although many of the experiments were carried out during the cooler season, but failures were fairly frequent in the corresponding experiments with flies from pupae kept at laboratory temperature. The increase in transmissibility by flies from incubated pupae was marked with trypanosomes from monkeys and Thomson's gazelle but much less so with those from sheep and reedbuck. Two experiments, in which flies from incubated pupae were fed on man and a bush-pig, gave infection rates of 17.6 and 12.5 per cent., respectively, in contradistinction to the poor transmissibility obtained with flies from normal pupae. Probably, transmissibility of *T. rhodesiense* from all hosts is raised when flies from incubated pupae are used, though not to the same extent.

In seven further experiments, flies of the two categories were fed concurrently on an infected host and then maintained so far as possible under identical conditions. Transmission was obtained in all the experiments with flies from incubated pupae and the infection rate was 10 per cent., whereas two failures in transmission occurred in the experiments with flies from normal pupae and the infection rate was only 2.3 per cent. in the remainder. The difference is significant. Transmissibility seemed to be raised further by incubating the pupae for a longer period (with incubation periods of 1-2, 4-8 and 13 days).

The period required for development of the trypanosome in the fly tended to be shortened by incubation of the pupae. Mortality appeared somewhat higher among incubated than among unincubated pupae, but the records are not precise as the proportion parasitised by *Thyridanthrax* was not noted. The proportion of flies that survived to be examined was significantly higher when the pupae were incubated. The shorter trypanosome cycle would contribute to this. Infected flies from the two categories survived about the same time.

Factors influencing the transmissibility of trypanosomes by tsetse flies are considered from the literature. It is evident that properties of both the trypanosome and the fly play an important part. F. L. Vanderplank found in independent observations in Tanganyika in 1943 that the transmissibility of *T. congolense* by *G. swynnertoni*, Aust., and *G. morsitans* is also increased by incubation of pupae. This supports the view that the principle involved is one applying to trypanosomes and tsetse flies generally. A list of questions arising out of the work is given. With regard to the microclimate to which pupae are exposed in the field, the author found the highest infection rate among *G. brevipalpis*, Newst., at Amani following the coolest period of the year [R.A.E., B 31 183]. He suggests that, as this is the time when deciduous plants lose their leaves, the ground is exposed to the sun and the temperature experienced by pupae probably reaches its maximum.

In the second paper, observations on the relation of the sex of the fly to transmission are recorded. The ratio of the infection rate in males to that in females exceeded 2:1 whether the flies had emerged from pupae kept at laboratory temperature or from pupae incubated at 30°C. Males and females emerged at Tinde in nearly equal numbers from both incubated and unincubated pupae, but the death-rate among females was higher than among males throughout the period of their maintenance in boxes, and the disparity became greater

as the experimental age of the flies increased. Since the highest male-female survival ratio coincided with the highest male-female infection ratio, and the greater death-rate in females is contrary to what takes place in nature [cf. 24 240 ; 29 124] or under other conditions of maintenance, the author suggests that the high rate of mortality in the female flies was primarily responsible for the disparity found in the infection rate in the two sexes. He concludes that in Duke's work with *G. palpalis*, R.-D., the death-rate was only very slightly greater in the females than the males, and there was no significant difference in rate of salivary-gland infection between the two sexes [cf. 18 175 ; 21 205]. He suggests that the two species respond differently to maintenance in fly-boxes, *G. palpalis* being better able to withstand mass confinement than *G. morsitans*. In the experiments at Tinde, the survival ratio between the sexes was normal only when the flies had been placed singly in bottles and had fed. It thus appears that to determine whether the sexes of *G. morsitans* differ in infertibility with trypanosomes, work with flies kept singly must be undertaken.

KIRK (R.) & LEWIS (D. J.). **Taxonomy of the Ethiopian Sandflies** (*Phlebotomus*). I. **Classification and Synonymy**.—*Ann. trop. Med. Parasit.* 40 no. 1 pp. 34–51, 29 refs. Liverpool, 1946. II. **Keys for the Identification of the Ethiopian Species**.—*T. c.* no. 2 pp. 117–129, 56 figs., 5 refs.

The first part of this paper comprises a discussion of the classification of Old-World sandflies (*Phlebotomus*), of which three subgenera are recognised, a section on the synonymy of *P. minutus*, Rond. (a species that does not occur in the Ethiopian region) in which the nomenclature followed is that of Parrot [cf. *R.A.E.*, B 31 244–245 ; 32 66], and a catalogue of the Ethiopian species, showing their synonymy and distribution and including notes on the characters of varieties.

The second part comprises keys to the known males and females of the Ethiopian species with notes on their use. Varieties are not included. Lists are given of species that are excluded from the keys because they are *nomina nuda* or of doubtful status, of Palaearctic species omitted because records of them from the Ethiopian region are erroneous, and of species of which only one sex is known.

BURTT (E.). **Salivation by *Glossina morsitans* on to Glass Slides : a Technique for isolating infected Flies**.—*Ann. trop. Med. Parasit.* 40 no. 2 pp. 141–144, 2 pls., 4 refs. Liverpool, 1946.

A description is given of a simple technique for making preparations of the salivary forms of *Trypanosoma rhodesiense* from living infected adults of *Glossina morsitans*, Westw., devised at Tinde, Tanganyika, to facilitate the obtaining of information regarding the numbers of trypanosomes that an infected fly can eject when it feeds. A slide is first smeared with egg albumen, which is allowed to dry. A gauze-covered bottle containing an infected tsetse fly is then placed mouth-downwards in a rack and a guineapig put close under it. As the fly extrudes its proboscis through the gauze in an attempt to feed, the slide is interposed so as to come into contact with the tip of the proboscis, the fly continues to probe on the surface of the slide and saliva containing trypanosomes is ejected on to it. The smear is fixed and stained.

In parallel tests in which this probe method of detecting infection and the method of detection by isolation on rats [cf. *R.A.E.*, B 37 136] were compared by first obtaining a smear from a hungry fly and immediately allowing the fly to feed on a rat, 142 flies were found to be positive by both methods, 17 by slide only and 24 by rats only. However, in a further experiment in which a probe

and feed test was followed by a second probe test ten days later, 24 flies were found to be positive by both methods, three by slides only and none by rats only. In 4,101 flies tested, 46 extruded only proventricular forms when infection was first detected. Of these, 17 eventually became infective. This pointed to the conclusion that the full number of flies with infected glands in any transmission experiment could be found if probe tests were made over a period of about ten days, every time the fly was hungry. Flies infected with *T. simiae* were also detected by the probe technique, but usually only after repeated tests had been made.

Features shown by the technique are described and illustrated. Bacteria were observed in the saliva of 13 of 246 flies that were infected with *T. rhodesiense* and in that of 13 of 3,610 that were not. Some infected flies, with bacteria, were tested on man, but no abnormal results were produced.

UNSWORTH (K.) & GORDON (R. M.). **The Maintenance of a Colony of *Phlebotomus papatasi* in Great Britain.**—*Ann. trop. Med. Parasit.* **40** no. 2 pp. 219–227, 3 figs., 24 refs. Liverpool, 1946.

Techniques whereby *Phlebotomus* could be satisfactorily reared in the laboratory were first devised in 1922 [*R.A.E.*, B **10** 125; **11** 61]. From that time, many different methods were used, but all were modifications of that described by Smith [**13** 122], who confined naturally fed females in small glass cylinders covered at the upper end with muslin and placed upright in petri dishes containing water. After 2–3 days, the females were transferred for oviposition to another glass cylinder standing on a plaster tray containing pebbles together with rabbit faeces as food for the larvae. The tray rested on damp cotton-wool in an earthenware pot, which was placed in water in a petri dish to maintain the desired humidity. After the eggs had hatched, the glass cylinder was replaced by an earthenware cover to give the necessary humidity and darkness for the larvae. Subsequent modifications of equipment, temperature, light and food are reviewed. In most methods, the adults were fed on the arm of a human volunteer.

Although these procedures, which were based on observations on the breeding places of *Phlebotomus* in nature, were satisfactory for rearing sandflies in the countries in which they naturally occur, efforts to establish and maintain a colony in England failed, until the authors developed two methods of maintaining a strain of *P. papatasi*, Scop., from Palestine. In both, the entire life-cycle was passed in the dark at 30°C. [86°F.] in an incubator [*cf.* **15** 100; **32** 90], except for the few minutes each day when the cultures were examined in daylight. In the first, which was a modification of an early one [**14** 139, 145], the adults as they emerged were placed in lamp glasses plugged with cotton-wool at the narrow end and covered with organdie and, except during feeds, damp lint at the wide end, and containing a piece of card as a resting place, and they were fed on a human volunteer. Females ready to oviposit were transferred to egg-laying chambers consisting of lamp glasses with the narrow end standing in an earthenware pot surrounded by damp soil and packed in with damp cotton-wool and the wide end covered with damp lint. Food for the larvae was added shortly before the eggs were due to hatch. When pupae appeared, the pots were uncovered and placed in cages from which the adults could be collected easily.

A colony was established by this technique and maintained through three generations, but the handling of the material took too much time when the sandflies became numerous. A simplified technique was therefore devised in which the complete life-cycle was passed in one apparatus and feeding on man was avoided. The apparatus was designed on the principle of a rodent burrow and a baby rat was used as host, as fed sandflies have often been recovered

from rodent burrows [cf. 28 202; 34 77, etc.] and it was assumed that the rodents had supplied the blood-meal. A cubical block of porous cement with a side of 6 ins. was cast to enclose an elongated horizontal chamber  $3\frac{1}{2}$  ins. wide by  $2\frac{1}{2}$  ins. deep at one end and 1 in. wide by 1 in. deep at the other, open at both ends and having a removable roof. Two projecting ridges half way up the walls of the chamber at the wide end support a cork tray holding the rat (less than three weeks old). Two cylindrical wells 1 in. in diameter running vertically through the block to within 1 in. of the base, one on each side of the chamber, maintain the proper degree of moisture in it if filled with water every two days. When in use, the block is placed between runners on a plywood base, and cages fitted into felt-backed plywood slides close each end of the chamber. The cage on the wider end has an organdie sleeve, while that at the narrow end has a small hole, through which the sandflies are introduced into the chamber. Before use, the block is soaked in water and allowed to drain. The floor of the chamber is then covered to a depth of about  $\frac{1}{8}$  in. with soil and rabbit faeces, the block is warmed in an incubator at 30°C. for 24 hours and placed on the base, the cages are put in position and the whole is secured by wedges. Adult sandflies are then introduced, and given an opportunity to feed on the rat every morning. The rat is lightly restrained on the tray by mosquito netting fastened down with drawing pins. By the use of these two techniques, the strain has been maintained in England for eight months (up to the time of writing) and through five generations.

Observations on individual sandflies were best made by the first technique. Females fed readily on the arm of a volunteer. Except on the day after emergence and the two days preceding oviposition, they usually fed during the first 20 minutes or refused for the day. Most took four blood-meals, often on consecutive days, before a refusal to feed indicated that they would soon oviposit. Of 48 females observed, one oviposited after one blood-meal, 13 after three, 27 after four, and seven after five. Oviposition took place 7–12 days after emergence. The maximum number of eggs laid by a female was 66, the minimum three and the average 19. The incubation period in 24 batches averaged six days. Most larvae pupated after 25–30 days, generally in the drier and more superficial layers of the food-material or on the sides of the containers. The average duration of the life-cycle was about six weeks, and the number of adults emerging was 28–57 per cent. of the number of eggs laid.

BERTRAM (D. S.), UNSWORTH (K.) & GORDON (R. M.). **The Biology and Maintenance of *Liponyssus bacoti* Hirst, 1913, and an Investigation into its Rôle as a Vector of *Litomosoides carinii* to Cotton Rats and White Rats, together with some Observations on the Infection in the White Rats.**—*Ann. trop. Med. Parasit.* 40 no. 2 pp. 228–254, 1 pl., 20 refs. Liverpool, 1946.

No strain of filariasis adapted for chemotherapeutic investigation and having a host and vector easy to maintain in the laboratory was known until the discovery by Williams & Brown that *Litomosoides carinii* could be transmitted to cotton rats (*Sigmodon hispidus*) by *Liponyssus bacoti*, Hirst [R.A.E., B 37 132]. Soon afterwards, *L. bacoti* was found in the bedding sawdust of ten infected cotton rats sent to Liverpool from Canada, and investigations on the mite and filaria and the transmission of the latter to *S. hispidus* and white rats were begun. The method finally evolved for maintaining *L. bacoti* was to keep the mites in a standard biscuit tin 9.5×8×8 ins. in size containing a 3-in. layer of sterilised sand and earth, or sand alone, on which stands a 6-in. cubical wire cage containing a cotton rat or a white rat. The space round the cage is packed with wood shavings. The turned-in flange at the top of the tin

prevents the mites from escaping, and the tin is mounted on legs over a water surround. An important advantage of this method over others [cf. 37 133] is that transmission can be more certainly achieved, since the mites necessarily swarm on to any new host.

The following is based on the authors' summary of the work. Techniques for maintaining the mite and transmitting the filaria are described and discussed. The habits of *L. bacoti* and the appearance of the different stages are described, with special reference to its maintenance and manipulation in experiments. The stages in the life-cycle consist of egg, non-feeding larva, blood-sucking protonymph, non-feeding deutonymph and adult. Each immature stage moulted once [cf. 34 138]. Two blood-meals, one by the protonymph and one by the adult, are required to complete the life-cycle, which lasts 10–12 days at 25°C. [77°F.]. Females could reproduce without pairing, but the sex of their offspring was not determined. Adult females were kept alive for 33 days on six engorgements, eggs up to a maximum of 12 being laid between meals. Unfed protonymphs, males and females survived for 6, 11 and 10 days, respectively.

Microfilariae are taken up in considerable, although variable, numbers by nymphs and adults of *L. bacoti*, but only a few develop to later stages. No developmental forms were found in mites exposed to infection as nymphs, but five out of 11 females exposed to infection in the first adult meal showed 1–5 parasites 420–935 $\mu$  in length (late developmental forms) after 20–33 days. The parasite 935 $\mu$  long, presumed to be an infective form, was found 33 days after the infective meal. The method of transmission to the rodent host was not observed.

*Litomosoides carinii* was transmitted to cotton rats and to white rats as a result of exposure to infective mites. Post-mortem examination of white rats first exposed to infection 74 or 82 days previously revealed adult worms and microfilariae in the pleural cavity and microfilariae in the heart blood, but microfilariae were not found in the peripheral circulation at the time of autopsy. Dead, fragmented and encapsulated worms and marked cellular reaction against the microfilariae were observed in white rats exposed to infection by infective mites. Such changes were not observed in the one cotton rat exposed to infection under the same conditions or in naturally infected cotton rats. When *L. carinii* was surgically transferred to the pleural cavities of white rats, microfilariae appeared in the blood 14–18 days after transfer, and in some cases persisted until autopsy 22–23 days later. Post-mortem examination made either at the first appearance of the microfilariae or after they had persisted for several days showed the adult worms to be encapsulated, dead and fragmented. Although the bulk of the results are not yet available, it is suggested that caution be observed in accepting the white rat as a satisfactory host of *L. carinii* for chemotherapeutic research.

BERTRAM (D. S.). **An Apparatus for collecting Blood-sucking Mites.**—*Ann. trop. Med. Parasit.* 40 no. 2 pp. 209–214, 2 figs., 1 ref. Liverpool, 1946.

A description is given of an apparatus devised in the course of work on *Liponyssus bacoti*, Hirst [cf. preceding abstract] for separating the mites from the sawdust or mixed sand and earth that forms the bedding of the rodent hosts, together with instructions for its use. The principle is that of a heated hollow cylinder surrounding and moving slowly along a long glass tube containing the infested material and driving the mites before it into a terminal chamber, which incorporates a device for controlling condensation within the tube. Infested cotton fibre is not suitable for direct treatment as the mites become trapped in the fibres and killed. This difficulty was overcome by teasing out such materials into sawdust, which is then treated.

In some preliminary observations on the effect of contact insecticides on the mites, the apparatus was used to induce the mites to move over a treated surface for a known distance in a known time.

GARDINER (J. G.). **Report of the Minister of Agriculture for the Dominion of Canada for the Year ended March 31, 1946.**—235 pp. Ottawa, 1946.

Experiments at Ottawa described in the entomological section of this report (pp. 63–83) showed that powders containing 3, 5 and 10 per cent. DDT and emulsified solutions containing 0.25 and 0.5 per cent. were every effective in ridding cattle of lice. About 4 oz. powder or three pints spray were used for each animal. Spraying a 150-acre swamp in Ontario from an aeroplane in late April 1945 with a 2 per cent. solution of DDT in diesel oil at 2 gals. per acre gave excellent control of mosquito larvae, and a summer resort in which mosquitos had been very troublesome in the previous season was free from them for two months. The Anopheline mosquito survey of the Dominion begun in 1944 [R.A.E., B 35 46] was continued, and the mosquitos taken during 1945 included five of the genus *Anopheles*, *A. maculipennis* var. *freeborni*, Aitken, being found in British Columbia [cf. 35 47].

It is reported from the Dominion Experimental Fox Ranch, Summerside, Prince Edward Island (pp. 119–121) that an aqueous preparation of A10 Neocid (a powder containing 10 per cent. DDT) painted on pen doors and the outer surface of feed boards caused a noticeable decrease in flies for six weeks. The 10 per cent. DDT powder used to dust 20 adult foxes and 20 pups eradicated fleas, and had no deleterious effects on the skin or fur of the foxes. The DDT was found to be relatively non-toxic to foxes, doses of 0.5–10 gm. of 10 per cent. powder in food causing no symptoms of poisoning in adult foxes or pups six months old.

SATCHELL (G. H.). **The Ecology of the British Species of *Psychoda* (Diptera : Psychodidae).**—*Ann. appl. Biol.* 34 no. 4 pp. 611–621, 2 figs., 14 refs. London, 1947.

Of the 16 species and two subspecies of *Psychoda* known to occur in Britain, *P. alternata*, Say, *P. severini parthenogenetica*, Tonn., and *P. cinerea*, Banks, have colonised the bacteria beds of sewage works [R.A.E., B 34 105]. These sewage-breeding species are sometimes so abundant that they become a household nuisance, and cases of bronchial asthma caused by inhaling the dust resulting from disintegration of their bodies have been reported. Any attempt at assessing the dispersal of *Psychoda* from sewage works requires knowledge of the breeding places and seasonal incidence of the local species. Adults were therefore collected between October 1942 and July 1944 in the neighbourhood of Leeds from three farms and three woodland areas bordering on pasture, some close to sewage works and some at such a distance that dispersal from the works was unlikely to affect the fauna. The results are given and discussed. The breeding media used were found to be field dung, decaying vegetable matter and organic mud [cf. *loc. cit.*]. Some species confined themselves to one of these media, while others bred in various materials. *P. alternata* breeds only in very wet and foul environments and is not a normal inhabitant of farms, so it proved the best indicator of dispersal from sewage filters. Larvae of *P. severini* feed on almost any moist decaying vegetable matter, and layers of dung and straw in cowsheds were used for breeding by adults coming in from the sewage works. This species was thus an indication of the cleanliness of a farm rather than of infiltration. It did not breed in stacked dung. Invasion of woodland and of farms by *P. alternata* was apparent at distances of up to a mile from the filters, but not at 1½ miles in the direction

of the prevailing wind. The seasonal incidence of *P. alternata* and *P. severini* from natural breeding places and filter beds differed owing to the effect of competition in the latter [26 113; 28 151] and the warmth of the beds.

ACHARYA (C. N.) & KRISHNA RAO (K. S.). **Experiments on the Control of Fly-breeding in Compost Trenches.**—*Indian J. agric. Sci.* 15 pt. 6 pp. 318–327, 2 figs., 25 refs. Delhi, 1946.

Available methods of preventing the development in the compost trenches used for town wastes in India of Dipterous eggs and larvae present in the refuse and excreta before they arrive at the Compost Depot are briefly reviewed, and a few of the more promising are described. It is concluded that a simpler and cheaper method than any so far published is needed to be practicable [cf. *R.A.E.*, B 35 1]. An account is given of experiments carried out with *Musca domestica*, L., as a result of which three methods were developed that fulfilled these conditions and gave at least 95 per cent. control. These are covering the compost (composed of alternate layers of 3 ins. dry refuse and 1 in. excreta) from the sixth to the 13th day with a mixture of equal parts of fine earth and cattle dung and enough water to form a thick plaster; covering it for the same period with drill cloth coated with tar on both sides [cf. 28 174–175] or hessian treated with earth-dung plaster and then coated with tar; and placing a layer of dry refuse 6 ins. thick over a 2-in. layer of earth on the material and burning it on the sixth and tenth days. The first two depended on the setting up of anaerobic conditions. The earth-plaster cover is simple, but it delays decomposition, close supervision is needed for a week to ensure the closing of all cracks and it is often difficult to obtain enough earth and dung. However, it may be useful for small quantities of refuse either in trenches or heaps. Fire works well in trenches in the dry season, and burning on the sixth day only might be effective for slightly infested material, though it was not where infestation was heavy. The disadvantages of the method are shortage of refuse in proportion to excreta, lack of dry refuse in the wet season and loss of humus and nitrogen. It was not very suitable for heaps. The tarred cloth method, which was about as effective as the earth-plaster cover and can be used for heaps or trenches, is considered the most useful and economical. Its success depends on the care with which the cloth is fixed to the ground by a layer of the earth-dung plaster above and below [cf. 35 1]. Any cracks that appear in the plaster should be closed up daily.

MACKERRAS (M. J.) & ERCOLE (Q. N.). **Observations on the Development of human malarial Parasites in the Mosquito. I. Morphological Changes.**—*Aust. J. exp. Biol. med. Sci.* 26 pt. 5 pp. 439–447, 1 col. pl., 2 figs., 17 refs. Adelaide, 1948. **II. Factors influencing Infection.**—*T. c.* pp. 449–458, 2 figs., 8 refs.

The following is based on the authors' summaries. The morphology of the early stages of New Guinea strains of *Plasmodium vivax* and *P. falciparum* in *Anopheles punctulatus*, Dön., and the methods used in studying them in an investigation made in northern Queensland from 1943 to 1946 are described. In both species, exflagellation was observed in five minutes and fertilisation in ten minutes after ingestion of gametocytes. Most zygotes had reached the vermicle stage in 24 hours and had penetrated the wall of the mid-gut in 48 hours. The developmental period was shorter for *P. vivax* than for *P. falciparum* at all seasons. The mean duration varied from 9 days in mid-summer (mean monthly temperature 82°F.) to 16 days in mid-winter (mean monthly temperature 72.5°F.) for *P. vivax* and from 11 to 19 days in the same seasons for *P. falciparum*. The minimum durations observed in mid-summer

were 8 days for *P. vivax* and 9 days for *P. falciparum*. A steady depletion of sporozoites was noted in mosquitos having access only to carbohydrate food, as well as in those having blood-meals in addition.

Infection in the mosquito depended chiefly on the maturity of the gametocytes, which could best be assessed by observing their behaviour in the gut of the mosquito 15–30 minutes after ingestion. If vigorous, free microgametes were seen, infection always developed in the mosquitos. When the male cells failed to exflagellate, the females frequently appeared normal at first and may have been functional. Unfertilised macrogametes, however, quickly disintegrated and disappeared. In general, the higher the gametocyte count the better the infection in the mosquito in both species, but large numbers in themselves did not ensure infectivity. Failure of *P. vivax* to infect mosquitos could not be correlated with any factor. Marked changes in infectivity in this species were recorded in as short a period as eight hours and were commonly observed to occur within 24 hours. The changes were thought to be due to the formation of successive waves of gametocytes, which circulated for a short period only and were infective for an even briefer time. No consistent non-infectors were observed among carriers of *P. vivax* infected with New Guinea strains. In *P. falciparum*, there was usually a period of low infectivity at the beginning of the gametocyte wave, and, in some patients at least, this was correlated with the occurrence of young, spindle-shaped gametocytes. Infectivity was usually greatest at the peak of the wave and then declined gradually, sometimes disappearing while the count was still high. Other patients were highly infectious throughout the wave. One carrier of *P. falciparum* consistently failed to infect mosquitos although the total counts were adequate, and another produced an extremely light infection on one occasion only. In these carriers, the male gametocytes seemed to be almost entirely non-functional. This lack of function could not be correlated with any other factor. The parasite suffered progressive decrease in numbers after ingestion by the mosquito. When total counts were low, the mechanical difficulties of the microgamete in finding a macrogamete were increased, and many macrogametes did not become fertilised. Leucocytes of the human host continued to phagocytose extracellular parasites for about five hours *in vitro*; they were active also after ingestion by the mosquito, and were responsible for the destruction of many gametocytes and zygotes. Neutrophils displayed the greatest activity, but monocytes and eosinophils also ingested gametocytes. A varying proportion of vermicules failed to penetrate the gut wall, and some of those that successfully formed cysts usually died and became chitinated before sporozoites were formed.

CERQUEIRA (N. L.) & BOSHELL-MANRIQUE (J.). **Note on *Haemagogus spegazzinii* Brèthes, 1912 (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **48** no. 8 pp. 191–200, 10 figs., 8 refs. Washington, D.C., 1946.

As it was important to determine whether specimens of *Haemagogus capricorni*, Lutz, and *H. spegazzinii*, Brèth., from the type areas corresponded exactly to supposedly similar material from Bolivia, Cerqueira & Lane obtained specimens of *H. capricorni* from the type locality in Brazil and published detailed descriptions of them [*R.A.E.*, B **35** 121], and in this paper descriptions are given of the adults of both sexes (including the male genitalia) and larva from material bred from females of *H. spegazzinii* from the type locality in Argentina and from Brazil (Cururipe and Ilhéus in Bahia and Arado in Mato Grosso). There was a close similarity between the specimens of *H. spegazzinii* reared from females from the type locality and those described originally by Brèthes as well as others described subsequently by Shannon & Del Ponte in a work already noticed [**17** 14]; and comparison with specimens of both sexes from Brazil and Bolivia showed conclusively that all belong to the same

species. It was also found that examples collected recently at Cururipe were identical with earlier material found by Antunes & Whitman to transmit yellow fever there and recorded by them as *H. janthinomys*, Dyar [26 65], which is a synonym of *H. spegazzinii* [37 26]. The fact that *H. spegazzinii* was the only species of this genus found in Ilhéus and Arado where yellow fever is endemic, and more recently (1945) in Goiaz, where epidemics of yellow fever have occurred, suggests that it is probably a vector in those localities.

PAPERS NOTICED BY TITLE ONLY.

- PAGÁN (C.) & LOUSTALOT (A. J.). **A simple rapid Method for estimating Toxicity (Rotenone Equivalent) of Derris Root.**—*J. agric. Res.* **77** no. 9-10 pp. 271-277, 4 graphs, 1 ref. Washington, D.C., 1948. [See *R.A.E.*, A **37** 259.]
- JONES (M. A.), PAGÁN (C.), MCGOVAN (E. R.), GERSDORFF (W. A.) & PIQUETT (P. G.). **A further toxicological Comparison of Derris and Lonchocarpus.**—*J. agric. Res.* **78** no. 7 pp. 191-196, 5 refs. Washington, D.C., 1949. [See *R.A.E.*, A **37** 260.]
- PAGÁN (C.) & LOUSTALOT (A. J.). **Comparison of chemical Values with the toxicological Rotenone Equivalent of Derris and Lonchocarpus Roots.**—*J. agric. Res.* **78** no. 7 pp. 197-205, 2 figs., 10 refs. Washington, D.C., 1949. [See *R.A.E.*, A **37** 260.]
- MCINTOSH (A. H.). **Relation between Particle Size and Shape of insecticidal Suspensions and their Contact Toxicity. I. D.D.T. Suspensions against *Tribolium castaneum* Hb.**—*Ann. appl. Biol.* **34** no. 4 pp. 586-610, 1 pl., 7 figs., 15 refs. London, 1947. [See *R.A.E.*, A **37** 263.]
- CHISHOLM (R. D.) & KOBLITSKY (L.). **Effect of Light on DDT Residues.**—*Agric. Chem.* **2** no. 9 pp. 35, 37, 7 refs. Baltimore, Md., 1947. [See *R.A.E.*, A **37** 234.]
- NEL (R. G.) & DÜRR (H. J. R.). **The Rate of CO<sub>2</sub> Production by Cockroaches dusted with DDT and other insecticidal Dusts.**—*J. ent. Soc. sthn Afr.* **9** no. 2 pp. 115-126, 1 fig., 12 graphs, 2 refs. Pretoria, 1947. [See *R.A.E.*, A **37** 264.]
- SEDDON (H. R.). **Host Check List of Helminth and Arthropod Parasites present in domesticated Animals in Australia with Notes on their Presence in the several States and Lists of Parasites which have not become established, doubtful Records, etc.**—*Serv. Publ. (Div. vet. Hyg.) Dep. Hlth Aust.* no. 2, 41 pp. Canberra, 1947.
- GORDON (R. M.) & HILL (M. A.). **A Technique for obtaining Bacteria-free Suspensions of Sporozoites from the Salivary Glands of infected Mosquitoes.**—*Ann. trop. Med. Parasit.* **40** no. 1 pp. 113-115, 5 refs. Liverpool, 1946.
- GOUIN (F.). **Morphologie de l'appareil rostral de l'imago de *Stomoxys calcitrans* L.**—*C. R. Acad. Sci.* **223** no. 15 pp. 559-560, 1 fig. Paris, 1946.
- GOUIN (F.). **Le mécanisme de la piqûre chez *Stomoxys calcitrans* L. ; comparaison avec les diptères cyclorrhaphes suceurs.**—*C. R. Acad. Sci.* **223** no. 16 pp. 599-600, 3 refs. Paris, 1946.
- ROSS (H. H.). **A Textbook of Entomology.**—9 $\frac{1}{4}$  × 6 ins., ix+532 pp., 434 figs., refs. New York, J. Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., 1948. Price \$6 or 36s. [See *R.A.E.*, A **37** 261.]

JOHNSON (C. G.). **Field Tests on some Pyrethrum anti-mosquito Repellent Creams against Woodland Species of *Aedes* in Britain.**—*J. trop. Med. Hyg.* **50** no. 2 pp. 32–36, 1 ref. London, 1947.

In the field tests described, which were carried out in southern England in 1942, various creams containing pyrethrins were tested for repellency to *Aedes* spp. in comparison with one of 28 per cent. citronella oil in a base of hard and soft paraffin which was known to be ineffective in practice. This gave totally inadequate protection, as did 1 per cent. pyrethrins in the same base, and both were unpleasant to use. A preparation containing 1 per cent. pyrethrins made up of 5 ml. pyrethrum extract (40 per cent. pyrethrins), 10 ml. methylated spirit, 6 gm. gum tragacanth, 6 gm. glycerine and water up to 200 gm. was much more pleasant to use and more effective over a longer time. It did not give complete protection even after one hour but was still giving about 70 per cent. protection after 7–8 hours. When the proportion of pyrethrins was halved, the degree and duration of protection were somewhat less. The results suggest that the protection afforded by a pyrethrum and tragacanth cream decreases during the first four hours and then increases somewhat for the next two or three hours. The cream dries as small flakes adhering to the skin, but there was no advantage in adding citrus pectin to make it less liable to flake off. Since the pyrethrum acts mainly by contact, every exposed part must be covered with the cream.

LODGE (F. E.) & THOMAS (W. R. G.). **The Breeding of Mosquitoes in the Weepholes of Stone Pitched Drains.**—*E. Afr. med. J.* **23** no. 5 pp. 147–150. Nairobi, 1946.

Observations in Kenya in December 1944 and October 1945 indicated that mosquito breeding in the weepholes of stone-pitched drains is improbable, as the water tends to be continually moving and any eggs laid would probably be washed away before they hatched. Silting is of such nature as to facilitate this washing away. Larvae of *Anopheles gambiae*, Giles, introduced into the weepholes, survived under certain conditions, but no natural breeding was found in over 700 examinations.

COLLESS (D. H.). **The Anopheline Mosquitoes of north-west Borneo.**—*Proc. Linn. Soc. N.S.W.* **73** pt. 3–4 pp. 71–119, 20 figs., 32 refs. Sydney, 1948.

Keys, based on those of Russell, Rozeboom & Stone [*R.A.E.*, B **32** 102], are given to the females and fourth-instar larvae of species of *Anopheles* taken between June 1945 and January 1946 in a coastal strip of north-west Borneo, lying partly in Sarawak and partly in British North Borneo, and certain other species recorded from Borneo or possibly occurring there. The local distribution of each of the 21 forms found and examined by the author is given, together with descriptions of various stages (adults of both sexes and larvae) from examination of the local material and notes on bionomics for all except one, of which only one larva was taken. A list is included of types of breeding places in which the various species are usually found.

*A. leucosphyrus*, Dön., was represented by two subspecies, one named *pujutensis*, n., and the other considered to be *A. l. balabacensis*, Baisas. The larva and adults of both sexes of both are described and the distribution of members of the *leucosphyrus* complex [*cf.* **24** 234, etc.] in Borneo and elsewhere is discussed. *A. leucosphyrus* was found to be an important vector of malaria in Borneo by McArthur [**36** 203], but it is doubtful to which subspecies his record refers. Of seven forms of which the blood preference was studied, *A. l. balabacensis* showed the greatest tendency to feed on human blood, followed by *A. hircanus nigerrimus*, Giles, *A. separatus*, Leic., *A. tessellatus*,

Theo., *A. barbirostris*, Wulp, *A. philippinensis*, Ludl., and *A. kochi*, Dön. Females of all species of which any were available were dissected for malaria parasites. The only infection found was one gut infection in *A. barbirostris*, and the potentialities of this species as a vector should not be overlooked, although it is mainly zoophilous. *A. sundaicus*, Rdnw., and *A. umbrosus*, Theo., are also considered of potential importance. Females of the former entered houses in search of blood and females of the latter were frequently taken biting under jungle cover. The author regards *A. novumbrosus*, Strickland, as a synonym of *A. umbrosus*; it was distinguished from the latter mainly by characters of the larvae [5 10], but he considers that the original description of the larva of *umbrosus* applied not to that species but to *A. letifer*, Sandosham [36 92].

BAILEY (N. S.). *Trichopria tabanivora* Fouts in Massachusetts (Hymenoptera, Diapriidae).—*Psyche* 54 no. 2 p. 142, 2 refs. Cambridge, Mass., 1947.

A score of adults of *Trichopria tabanivora*, Fouts, emerged from one of two pupae of *Tabanus nigrovittatus*, Macq., found in a pile of drift near a marsh in Massachusetts in August 1946. This is believed to be the first record of the Diapriid published since Cameron's original ones [*R.A.E.*, B 14 165].

MAAS (E. E.). Arsenic Content in Urine from Cattle dipped in arsenical Solutions. —*J. Amer. vet. med. Ass.* 110 no. 841 pp. 249–250. Chicago, Ill., 1947.

As the death of several cattle that had been dipped in an arsenical solution during the campaign for the eradication of ticks [*Boophilus annulatus microplus*, Can.] from Porto Rico [cf. *R.A.E.*, B 37 89] was attributed to arsenical poisoning because arsenic was found in their urine, investigations on the excretion of arsenic in urine were made in Porto Rico in April and May 1946. The average arsenic content of the urine of four cows that had not been dipped for over a year was found to be 0.02 mg. per litre. That of four cows that had been dipped once a fortnight since 9th January in solutions containing 0.18–0.19 per cent. arsenious oxide was 0.2 mg. per litre on 18th April, 14 days after dipping. Two of these cows were then dipped in 0.22 per cent. arsenious oxide and two in 0.185 per cent. and after 24 hours the urine of the first two contained 3.2 and 8 mg. and that of the other two 2.8 and 8.8 mg. arsenic per litre, respectively. Samples collected from these four cows 48 and 80 hours after dipping all contained about 4 mg. per litre. No rainfall was registered during these 80 hours. Samples from cattle similarly dipped in 0.18–0.19 per cent. solutions and then once in a 0.22 per cent. solution and exposed to several showers contained only 2.6 and 1.6 mg. arsenic per litre 80 hours after dipping. None of the animals showed any signs of arsenical poisoning, and all the dairy cows continued regular milk production. Cattle deprived of water for about 24 hours after dipping eliminated 25–60 mg. arsenic per litre of urine at the end of this time. However, they showed no signs of poisoning apart from a slight desquamation of the skin in the regions of the udder, vulva and anus. It is concluded that the absorption of arsenic from normal official dippings was not shown to be detrimental to the health of cattle, and it is suggested that the medicinal value of arsenic absorbed by dipped cattle should be studied as there might be beneficial effect, especially in anaplasmosis and piroplasmosis, in addition to the control of Arthropod parasites.

[PETRISHCHEVA (P. A.).] Петрищева (П.А.). The Transition of *Aedes togoi* Theob. and *Aedes japonicus* Theob. (Diptera, Culicidae) to the synanthropic Mode of Life. [*In Russian.*]—*Ent. Obozr.* 30 no. 1–2 pp. 103–108. Moscow, 1948.

*Aedes togoi*, Theo., and *A. japonicus*, Theo., are the principal vectors of Japanese B encephalitis in the southern part of the Maritime Province of the

Soviet Far East, but each has its distinct area of distribution there, *A. togoi* being restricted to the rocky coast and *A. japonicus* to the primeval forest. They are typically associated with regions uninhabited by man, but become adapted to an association with man as soon as the opportunity arises. The various stages in this process were studied by the author in the Maritime Province, northern Korea and southern Manchuria.

In the Maritime Province, *A. togoi* occurred over vast coastal areas inaccessible to man but inhabited by sea-birds, on which the adults probably feed. The larvae were very abundant in rock-pools, lagoons and other bodies of water heated by the sun. Both adults and larvae were, however, also abundant in places not visited by birds, the larvae being found in all available water, even in deep fissures and in shaded cool sites. The first association of this species with man occurred in fishing camps, quarries and small settlements connected with lighthouses, especially those that included a few cattle or horses. The females entered inhabited quarters only to feed, and sheltered in outhouses by day when such were available. Larvae were occasionally observed in artificial water containers, but most of the breeding still occurred in natural sites. *A. japonicus* was not found outside the forest areas and was rather rare in nature, but became fairly common in summer resorts or settlements of workmen; numerous larvae and pupae occurred in water containers, and eggs were abundant on the sides of reservoirs.

In Korea and Manchuria, both species were abundant and completely domesticated in densely populated towns and villages. They had lost all connection with their original habitats, *A. togoi* occurring in ports and at a distance of several hundred miles from the coast, and *A. japonicus* in treeless areas far from the forest. The larvae developed in reservoirs and containers, and the females sheltered during the day in outhouses, usually avoiding vegetation, and fed on man and domestic animals.

These facts suggest that a similar spread of both *A. togoi* and *A. japonicus* may occur in the Soviet Far East as the settlement of uncultivated areas progresses, so that prophylactic measures should be taken in new settlements in previously unpopulated regions, particularly in natural foci of Japanese B encephalitis. Domestication made little difference in the seasonal activity of *A. togoi* and *A. japonicus*. Hibernation occurred in the egg stage, and larvae and pupae were present for long periods, those of *A. togoi* from the middle of April till the end of November and those of *A. japonicus* from the middle of May till the beginning of November. The larvae of *A. togoi* sometimes survived the freezing of the water down to three-quarters of its depth, which indicates the possibility of their surviving the winter in deep water, particularly if its salt content is high. Adults of *A. togoi* appeared in the second half of May, and those of both species occurred from June to mid-October, and, together with the larvae, were most numerous from mid-July to the end of September. The most dangerous period for the transmission of Japanese B encephalitis is from mid-July to early September, when the temperature is highest and favours the activity of the mosquitos and the virus in them.

[CHAGIN (K. P.).] Чарин (К. П.). Activity of Mosquitos in attacking Man and its daily Rhythm under natural Conditions in the Maritime Province. [In Russian.]—*Ent. Obozr.* 30 no. 1-2 pp. 109-123, 4 figs., 12 refs. Moscow, 1948.

The effect of meteorological factors on the aggressiveness of mosquitos and on the daily rhythm of their behaviour was investigated in a focus of Japanese B encephalitis in the Khasan district in the south of the Maritime Province of the Soviet Far East from 15th August to 28th September 1947. Summer

weather lasted until 4th September, with a daily temperature that fluctuated between 12.5 and 32°C. [54.5–90.5°F.], but the rest of September was autumnal, with cold nights and temperatures fluctuating between 6 and 29°C. [42.8–84.2°F.]. Collections of mosquitos seeking to attack man were made at various times of the day and night under a bell-shaped cover [cf. *R.A.E.*, B **35** 140, etc.] in a low-lying meadow near a village, and were supplemented by catches on the outer surface of the cover and in a cattle shed. Ten species of mosquitos were taken, and their breeding places were discovered nearby. Their abundance is shown in a table. The most numerous species were *Aedes vexans*, Mg., *A. dorsalis*, Mg., *Anopheles hyrcanus*, Pall., which was the only Anopheline taken, and *Culex modestus*, Fic. The numbers of the last two fell off considerably in autumn, and the two species of *Aedes* then constituted 95.1 per cent. of all the mosquitos taken in the open. *C. modestus* attacked exclusively outdoors, whereas the three other species did so both in the open and indoors. Three of the known vectors of Japanese B encephalitis, *C. tritaeniorhynchus*, Giles, *C. bitaeniorhynchus*, Giles, and *Aedes esoensis*, Yam., were present, but formed only a small percentage of the mosquitos taken. Of these, *C. tritaeniorhynchus* was commonest in the cattle shed and attacked man and animals indoors; in the open, it attacked chiefly late in the evening. Both *C. bitaeniorhynchus* and *A. esoensis* (which was the least numerous of the three) were aggressive only near their day-time shelters and rarely entered buildings. The observations, the results of which are given in detail and discussed, showed that the chief factors on which the incidence of mosquito attack depended were temperature, wind and light intensity [cf. **35** 141]. Reaction to them varied with species and did not remain constant for any one species throughout the season. Relative humidity between 70 and 100 per cent. had no effect on activity, and barometric pressure was too constant to permit conclusions.

[RUBTZOV (I. A.).] **Рубцов (И. А.). A new Palaearctic Species of Cavity Botfly (Diptera, Oestridae).** [In Russian.]—*Ent. Obozr.* **30** no. 1–2 pp. 138–142, 6 figs., 6 refs. Moscow, 1948.

Collections of *Rhinoestrus purpureus*, Brauer, an Oestrid that attacks horses, at the Zoological Institute in Leningrad were found to include some examples here described as *R. latifrons*, sp. n. The dates of capture on the labels suggested that *R. latifrons* is on the wing from early May to the end of August. The examples were taken between 1890 and 1933 chiefly in Mongolia and Kazakstan, with one from the Province of Chkalov, south of the Ural mountains. E. I. Gan recorded this species from the Province of Samarkand, Uzbekistan, in 1947, and stated that third-instar larvae were observed in the pharynx of horses. The possible origin of these two species and of *R. uzbekistanus*, Gan (1947), which attacks horses and donkeys in Uzbekistan, is discussed.

PHILIP (C. B.) & WOODWARD (T. E.). **Two new Species of Rat Mites (*Neoschöngastia* spp.) from a Focus of Scrub Typhus on Mindoro, Philippine Islands.**—*Amer. J. trop. Med.* **26** no. 2 pp. 157–163, 4 figs., 2 refs. Baltimore, Md., 1946.

PHILIP (C. B.), WOODWARD (T. E.) & SULLIVAN (R. R.). **Tsutsugamushi Disease (Scrub or Mite-borne Typhus) in the Philippine Islands during American Re-occupation in 1944–45.**—*T.c.* pp. 229–242, 1 map, 11 refs.

Tsutsugamushi disease was recorded in December 1944 in United States troops re-occupying the Philippine Islands, and the second of these papers comprises a report of investigations carried out there from then until August 1945 on its nature and epidemiology. It was not previously known

with certainty to occur in the Islands. The following is based on the authors' summary. Cases occurred in troops during actions on the islands of Leyte, Samar, Mindoro, Luzon, Negros and Mindanao, and Japanese troops were reported to have encountered the disease on Mindanao. The largest epidemics were on Mindoro and Samar; the widest distribution was encountered on Luzon. The case fatality rate was 4.5 per cent. A strain of *Rickettsia orientalis* was recovered in mice from a patient on Samar and was carried for seven passages. Cross-immunity with known strains of tsutsugamushi disease isolated in New Guinea and elsewhere was demonstrated.

The environments where infections were contracted varied. The foci are shown on a map and the environmental features described. Focal areas were encountered in fields of the common Philippine grasses "talahib" (*Saccharum*) and "kogan" (*Imperator*), as well as in neglected coconut groves with scrub undergrowth overlying both sandy and coralline floors. Most infections were contracted at or just above beach levels, but some came from mountain scrub areas as high as 3,000 ft. Outbreaks appeared to be more referable to exigencies of military operations than to detectable seasonable influence.

Rats indigenous to focal areas were identified as *Mus (Rattus) mindanensis*, *M. (R.) rattus umbriventer* and *M. (R.) vigoratus*. The first appeared to be the most important mite host. Both the known vectors [cf. *R.A.E.*, B 34 147, etc.] were taken on rats, *Trombicula deliensis*, Walch, on all the above islands except Leyte, and *T. akamushi*, Brumpt, on Luzon and Negros. Eight other species of Trombiculid mites were found on Philippine rats; they included the two new species of *Neoschöngastia* described in the first paper, and *Trombicula wichmanni*, Oudm., which was found attacking man on northern Luzon.

POLLARD (M.), LIVESAY (H. R.), WILSON (D. J.) & WOODLAND (J. C.). **Experimental Studies with Bullis Fever.**—*Amer. J. trop. Med.* 26 no. 2 pp. 175–187, 6 graphs, 12 refs. Baltimore, Md., 1946.

An account is given of a series of experiments designed to acquire some information as to the nature of the Bullis fever syndrome and its etiology [cf. *R.A.E.*, B 32 132; 33 164]. It is stated that all cases of this disease have had a history of exposure to the tick, *Amblyomma americanum*, L., but not all have been exposed to the mite, *Eutrombicula alfreddugèsi*, Oudm. No agent similar to that isolated from *Haemaphysalis leporis-palustris*, Pack., collected at Camp Bullis [33 141] has been isolated by the authors from any human cases of Bullis fever nor from any of the emulsions of *A. americanum* that were inoculated into guineapigs. It is concluded that the Bullis fever syndrome is a distinct clinical entity. It was reproduced in man by the inoculation of blood from febrile cases of the disease, or of strains of the agent from the blood of febrile cases and from an emulsion of ticks (*A. americanum*) from Camp Bullis, after these had been propagated for 20 and 12 serial transfers, respectively, in the yolk sac of the developing chick embryo. The immunological responses induced by natural cases of disease and by the two yolk-sac strains were the same, but the agent of Bullis fever did not confer immunity from Colorado tick fever [29 126]. The course of the induced infections is shown in graphs.

WILLIAMS (R. W.). **A Contribution to our Knowledge of the Bionomics of the common North American Chigger, *Eutrombicula alfreddugèsi* (Oudemans) with a Description of a rapid Collecting Method.**—*Amer. J. trop. Med.* 26 no. 2 pp. 243–250, 3 figs., 11 refs. Baltimore, Md., 1946.

An account is given of observations on the habits of larvae of *Eutrombicula alfreddugèsi*, Oudm. [cf. *R.A.E.*, B 28 246], made in 1942–43 in North Carolina.

It is emphasised that the mites feed on the epidermal cells of their hosts and rarely on blood [28 246; 29 197] and overwinter on the ears and eyelids of small mammals [cf. 25 220]. Larval mites were found in great numbers in June–August under or near blackberry bushes, possibly as a result of the activities of birds and rodents, and were collected by putting down a number of white saucers several feet apart. The mites were soon observed running on the saucers, and were removed by means of an aspirator. When one saucer was seen to attract more larvae than others, all were placed adjacent to it, as very large numbers of *E. alfreddugèsi* were sometimes concentrated in a very small area. When the plates were picked up and turned about, the mites showed a marked tendency to run upwards. Adult Bdellid mites of the genera *Bdella* and *Cunaxa* were taken together with *Eutrombicula*, and *Bdella* was observed to feed on the Trombiculid larvae.

SMITHBURN (K. C.), HADDOW (A. J.) & MAHAFFY (A. F.). **A neurotropic Virus isolated from *Aedes* Mosquitoes caught in the Semliki Forest.**—*Amer. J. trop. Med.* 26 no. 2 pp. 189–208, 19 refs. Baltimore, Md., 1946.

Four different viruses were isolated from mosquitos taken in forest in Bwamba County, Uganda, during 1942–44. They are the yellow-fever virus [cf. next abstract], the Semliki Forest virus [*R.A.E.*, B 34 87], one named the Bunyamwera virus, which is the subject of this paper, and a fourth, which is to be dealt with subsequently.

The Bunyamwera virus was isolated (by inoculation of a rhesus monkey [*Macaca mulatta*] and mice) from a pool of 4,114 mosquitos belonging to 14 species of *Aedes* caught in September 1943 in an uninhabited part of the Semliki Forest, the area concerned being one of three in Bwamba known as Bunyamwera. Species of *Aedes* predominated there, in catches both of biting mosquitos and of mosquitos resting in the undergrowth. The virus was pathogenic to white mice, and exerted its principal effects on the nervous system, regardless of the route by which it was introduced. The monkey inoculated with a suspension of the mosquitos died; a subinoculated rhesus monkey had fever and one inoculated from it did not, but both had antibodies. Rabbits inoculated with large doses of virus showed no clinical reaction, but all developed antibodies. Bunyamwera virus was immunologically different from the other viruses mentioned above, and all those with which the Semliki Forest virus was compared [34 88], and also from the viruses of Rift Valley fever and horse-sickness. Neutralising antibody against it was found in a forest monkey, in a man who had suffered a recent attack of febrile illness characterised by marked neurological signs and in a number of persons sampled at random.

SMITHBURN (K. C.) & HADDOW (A. J.). **Isolation of Yellow Fever Virus from African Mosquitoes.**—*Amer. J. trop. Med.* 26 no. 3 pp. 261–271, 17 refs. Baltimore, Md., 1946.

The authors report the isolation of yellow-fever virus from a batch of females of *Aedes simpsoni*, Theo., caught in June 1942 in a plantation at Bundinyama, near the southern edge of the Semliki Forest in Bwamba County, Uganda, 11 months after the effective mass immunisation of the human population. This, together with the fact that immunity was more prevalent among residents in close proximity to the forest [cf. *R.A.E.*, B 30 97], tended to support the view that infection in *A. simpsoni*, the principal local vector of the disease in man [cf. 31 61], was acquired from forest animals entering plantations in search of food. Further, a high incidence of immunity from yellow fever was found among all the principal species of monkeys known to inhabit the lowland forests of Bwamba. Attention was therefore turned to the main uninhabited forest area,

and intensive work was begun in January 1944 in a suitable area known as Mongiro, on the eastern border of the Semliki Forest. Yellow-fever virus was isolated in April from a lot of 80 *Aedes* mosquitos belonging to 12 different species, but not including *A. aegypti*, L., or *A. simpsoni*, thus establishing the existence of an extra-human cycle of virus activity. Most of the 12 species were exonerated on grounds of scarcity or restricted distribution. Of those remaining, *A. africanus*, Theo., was considered to be the most suspect [cf. 35 67].

STAGE (H. H.). **DDT to control Insects affecting Man and Animals in a tropical Village.**—*J. econ. Ent.* **40** no. 6 pp. 759–762, 1 fig. Menasha, Wis., 1947.

A campaign to control Arthropods affecting man and domestic animals by DDT sprays was carried out in 1946 in Moengo, an isolated bauxite-mining village of 1,500 inhabitants in Surinam. The village and its climate are briefly described. The aim was to treat every cow, donkey and dog in the village (except for three calves kept as controls) and the whole interior and exterior surface of every building. A water suspension containing 2.5 per cent. DDT prepared from a 50 per cent. wettable powder was used as a spray on about 100 cows, calves and a few donkeys, as a dip for about 90 dogs, and as a spray to leave a toxic residue on outhouses, huts, attics, the underside of flooring and the space under the houses and the interior of the author's house. As the deposit was unsightly, a 5 per cent. solution of DDT in oil was used on the interior of other houses. Screens were sprayed from both inside and outside. The oil spray was used at about 1 U.S. gal. per 1,000 sq. ft. and the suspension at about 1 U.S. gal. per 300 sq. ft.

The most conspicuous reduction in the mosquito population was seen in cow barns where 60 cows and a dozen calves sheltered each night. Hundreds of engorged mosquitos, of which about 10 per cent. were Anophelines, rested on the interior walls after dark before spraying, but two weeks after spraying, it was difficult to find any. The numbers of mosquitos taken in a light-trap in the centre of the village fell from about 900 and 400 in two nights' collections before treatment to 13 and 3 a few days after it. Later, there were even fewer mosquitos, although all other control measures were discontinued. Near breeding grounds with no buildings or animals within half a mile, there was no drop in the mosquito population. Mosquitos liberated in the author's house 2–3 months after treatment were found dead or dying after exposure for three or four hours, and 11 months after treatment, 2,000 mosquitos released in the house were all dead or showing signs of DDT poisoning after eight hours. Nearly all the mosquitos released in an identical house that had been sprayed with the oil solution were alive after eight hours, dozens were alive after 24 hours and two after 50. The residue from the suspension was still killing 60 per cent. of introduced mosquitos in seven hours 15 months after application.

Within 10 days of barns being cleaned and the barns and cattle sprayed with DDT, horn-flies [*Siphona irritans*, L.] and house-flies [*Musca domestica*, L.], which had both been very numerous, were almost exterminated. The improved situation was maintained for ten months by spraying cows each month with about 2 U.S. quarts DDT suspension each and cleaning the barns. The horn-flies are believed to have been eradicated. Within an hour of spraying a heavily infested house with the solution, 500 dead American cockroaches [*Periplaneta americana*, L.] were seen on the floor, about 25 ft. square. Less than 50 were found after the house was similarly retreated ten months later. Elsewhere at that time a reduction of about 90 per cent. was still apparent as a result of the original treatment. The few light infestations of bed-bugs [*Cimex*] in the village were apparently eradicated. Flea populations on treated dogs were high 11 months after dipping. Spraying reduced the number of *Boophilus*

*annulatus microplus*, Can., per cow from about 12 to 0·2 per animal, 8 days after the first application. After the 60 cows had been sprayed 11 times at intervals of 30 days, one tick was found on one of them, whereas the three control calves had 7, 9 and 10, respectively. Spraying of hen coops apparently eradicated *Argas persicus*, Oken. Three statements are quoted indicating that infestation of man by *Tunga penetrans*, L., ceased after treatment of the bauxite under the houses, which are raised on supports. Several dead toads, frogs and small snakes were found near houses treated a day or two before, and bats in an attic were killed by the treatment, but there was no evidence that song birds were affected.

YUST (H. R.). **DDT to control *Anopheles farauti* on Espiritu Santo, New Hebrides Islands.**—*J. econ. Ent.* **40** no. 6 pp. 762–768, 1 fig., 4 refs. Menasha, Wis., 1947.

The following is substantially the author's summary. *Anopheles farauti*, Lav., was controlled with DDT in the advanced military base on Espiritu Santo and adjacent small islands in the New Hebrides group. It was found to be more susceptible to a DDT deposit than is *Culex annulirostris*, Skuse, but more resistant than prevalent species of flies. Native huts in the uncontrolled area treated with 5 per cent. DDT in kerosene at the rate of 1 U.S. gal. per 1,000 sq. ft. were freed of adults of *A. farauti* for three months. This treatment was applied to all plantation buildings and native huts in and near the controlled area and was undoubtedly the most valuable use of DDT in reducing malaria infections. Breeding sites within and for at least one mile beyond camps were sprayed weekly with a 5 per cent. solution of DDT in oil at the rate of about 2 U.S. quarts per acre. Weekly spraying was necessary because of the continuous formation of new pools of water. During December 1943, before DDT was used, 41 primary malaria infections in troops were recorded, but no new infections were reported during November and December 1944. This must be attributed, in part, to the use of DDT.

WILLIS (E. R.). **The olfactory Responses of female Mosquitoes.**—*J. econ. Ent.* **40** no. 6 pp. 769–778, 2 figs., 13 refs. Menasha, Wis., 1947.

The following is largely the author's summary. A description is given of a modification of the Hoskins insect olfactometer [*R.A.E.*, A **23** 33; B **27** 166] that was developed and successfully used to test the responses of mosquitos to odours presented in air streams. The testing technique is also dealt with at some length. Data are given indicating that females of *Aedes aegypti*, L., and *Anopheles quadrimaculatus*, Say, that have not had a blood-meal are attracted by the odour of the human arm and hand when this odour is presented at 34°C. [93·2°F.] and 70–85 per cent. relative humidity, great precautions having been taken to eliminate complicating factors, and also that carbon dioxide in concentrations of 1, 10 or 50 per cent. by volume in air does not attract females of either species [*cf.* **10** 135, 190; **32** 75, etc.] when tested in the olfactometer.

SMITH (C. N.) & GOUCK (H. K.). **The Control of Chiggers in Woodland Plots.**—*J. econ. Ent.* **40** no. 6 pp. 790–795, 1 ref. Menasha, Wis., 1947.

Experiments on the control of Trombiculids in woodland plots [*cf.* *R.A.E.*, B **32** 200] were continued in Georgia in 1944–46. The species present were *Eutrombicula alfreddugèsi*, Oudm., and *E. (Acariscus) masoni*, Ewing, the former being the more numerous. Mite populations were assessed by exposing squares of black oilcloth for one minute. In 1944, 10 per cent. DDT in pyrophyllite at 1·9–6·5 lb. DDT per acre was not satisfactory. Dusting sulphur gave fairly

good control in one plot at 65 lb. per acre but not in four others at 13–64 lb. per acre. Dinitro-o-cresol at 3.2 lb. per acre as a 5 per cent. dust in pyrophyllite gave satisfactory control for a short period but caused severe injury to the vegetation.

In 1945, 2'-hydroxy-2, 4, 4, 4', 7-pentamethylflavan at 2–5 lb. per acre in sprays and 4 and 8 lb. as a dust in pyrophyllite, and an emulsified solution of crude BHC (benzene hexachloride), containing 10 per cent.  $\gamma$  isomer, in xylene at 2 and 5 lb. BHC per acre both gave good control [cf. 36 7], but results with both materials were inconclusive or unsatisfactory at 12 and 16 oz. per acre. Dusts of sulphur and wettable sulphur at 100 lb. per acre were effective in one test for 29 days, but in another, wettable sulphur at 104 lb. was fairly effective for only 15 days, as were both materials at 48 lb. per acre. Thanisol (an emulsifiable preparation containing 70 per cent. Thanite [36 165–166]) at 8 and 16 U.S. pints per acre in sprays was effective for a few days. Emulsions of dimethyl phthalate, benzyl benzoate or dibutyl phthalate in water at 5 U.S. pints active ingredient per acre, 10 lb. DDT per acre in pyrophyllite and 16 lb. derris per acre were not satisfactory. None of the materials was injurious to vegetation at the amounts used. There was apparently no difference in the resistance of the two species of mites.

In 1946, BHC and hydroxypentamethylflavan as emulsified solutions, suspensions and dusts at 2, 4 and 8 lb. per acre and various concentrations were compared, and three additional materials were tested. The specifications of the sprays and dusts used are given. Only *E. alfreddugèsi* was identified but *E. masoni* was probably present in small numbers. A dosage of 8 lb. hydroxypentamethylflavan or crude BHC per acre maintained a high degree of control (never more than 9 and usually less than 4 per cent. of the original infestations) through the period of observation (about eight weeks) in whatever form it was applied, but emulsions were distinctly the most and dusts the least effective at 2 and 4 lb. per acre. Effective control (0–6 per cent. of the original infestation) was maintained with both materials in emulsion at 4 lb. per acre and with BHC at 2 lb. Hydroxypentamethylflavan at 2 lb. was ineffective as an emulsion after about a month. When suspensions or dusts were used, hydroxypentamethylflavan gave somewhat longer control than BHC at 4 lb. per acre, but at 2 lb., control was of short duration with both materials. A light coverage of concentrated spray of either material gave at least as good initial control as a heavier coverage of dilute spray but the duration of effectiveness of the deposit was shorter. Applied as emulsions, chlordane and toxaphene [36 198–199] at 2, 4 and 8 lb. per acre gave as good control as hydroxypentamethylflavan at 4 lb. per acre throughout the 17 days of observation. Diphenyl carbonate was ineffective at 4 lb. per acre in an emulsion.

ROSENSTIEL (R. G.). **Dispersion and Feeding Habits of *Anopheles freeborni*.**—*J. econ. Ent.* 40 no. 6 pp. 795–800, 3 figs., 13 refs. Menasha, Wis., 1947.

The dispersion of *Anopheles maculipennis freeborni*, Aitken, from its breeding places and its feeding habits during dispersion were studied in two areas in central California in 1945, by examining females found in natural resting places. The sources of *A. m. freeborni* in both areas were isolated. No mass dispersal was observed in the spring or in the summer up to mid-July, but there was considerable local activity and blood-feeding in January and February. Autumn population movements consisted of a congregative phase during the last three weeks of August in the immediate neighbourhood of the breeding area followed in about a week by dispersal in large numbers into areas devoid of autumn or winter breeding places. This dispersal took place during September and early October and was most marked within ten miles of the

breeding area. It extended for at least 4.5 miles eastwards in one area and for at least 26 miles southwards in the other.

Blood-feeding was general during congregation and dispersal. The area within 1.5 miles of the breeding grounds had the greatest percentage and greatest actual numbers of females taking blood-meals. There was little feeding more than ten miles from breeding areas. No relation was apparent between blood-feeding and the density of farms. The females contained eggs during the dispersal, and hibernating females had a developed fat-body. The few females that were able to overwinter contained either eggs, fat or blood in February.

DORSEY (C. K.). **Population and Control Studies of the Palau Gnat on Peleliu, Western Caroline Islands.**—*J. econ. Ent.* **40** no. 6 pp. 805-814, 3 figs., 13 refs. Menasha, Wis., 1947.

Forces occupying Peleliu in 1944 found *Culicoides peliliouensis*, Tokunaga [*R.A.E.*, B **25** 154] to be the most annoying blood-sucking insect on the island. It attacks for preference the hands, wrists, arms, neck and ankles. The bites cause intensely irritating weals with consequent loss of sleep, and secondary infections often result from scratching. Feeding was heaviest from 6 p.m. to midnight and from dawn to 9.30 a.m. *C. peliliouensis* was observed by the author on five other islands of the Palau (Western Caroline) group. Its appearance and flight habits are described, and an account is given of observations on its bionomics and control made between October 1944 and November 1945. The length of the life-cycle was not ascertained, but it is believed to be considerable; the adults apparently survive for 7-10 days. Breeding takes place primarily in decomposing organic material along the margins of brackish, tidal, mangrove swamps, chiefly in parts not exposed to the direct action of the tide. Larvae were collected in swamps having a salinity range (total chlorides) of 600-20,000 parts per million. They were most numerous in swamps having a total chloride range of 2,000-5,000 p.p.m. at high tide. Breeding continues throughout the year, and periods of maximum and minimum populations occur twice each month and can be forecast fairly accurately by referring to tide tables. The maximum populations occur when the differential rise of the tides is small.

As the swamps cover at least one-fourth of the island and are inaccessible because of vegetation and mud, and as all parts of the island are near them, control is difficult. Repellents were of little value, dimethyl phthalate giving the best, but not adequate, protection. Head nets were of little use. Spraying screens, bed nets, head nets, etc., with 5 per cent. DDT in kerosene gave partial protection. In a series of insectary tests of larvicides, oil with and without DDT was entirely inadequate, but DDT at 3 and 5 per cent. in a xylene and Triton emulsion and at 10 per cent. as a dust was effective. A programme of aerial spraying using 5 per cent. DDT in oil was begun on 20th September 1944. By 1st June 1945, about 17,500 U.S. gals. spray had been used, application being made at 1-10 U.S. gals. per acre every week or ten days. Satisfactory control of mosquitos and flies was accomplished by early October, but there was still no apparent reduction in the population of *C. peliliouensis* in June.

It was concluded that the oil spray was ineffective, and power dusting from the ground was begun on 9th June and continued until 20th November. About 62,000 lb. 10 per cent. DDT dust was used on the swamp margins, and application was at 12-15 lb. per acre. About seven days were needed each time to treat the 500 acres of swamp margins where breeding was taking place. About two-thirds of the breeding area could be reached by the duster. Supplementary ground applications of emulsion containing DDT at 3-5 U.S.

gals. per acre were made for a short time from 20th July. During the time that the dust was being applied, the average population index of *C. peliliouensis* was less than one-fifth of what it had been during the period of oil spraying. Had equipment for dusting from the air been available, results would probably have been considerably better. Living larvae were difficult to find in the areas treated with the emulsion. It is concluded that 10 per cent. DDT dust applied regularly to breeding places 3-5 days before the anticipated periods of maximum population at 12-15 lb. per acre reduces the population to a point at which it is no longer very troublesome. Emulsion containing DDT is effective when applied to the water and mud of the breeding sites at 3-5 U.S. gals. per acre, but coverage is not so complete or extensive as with dust. No adverse effect on birds, fish, crabs, indigenous mammals or general insect life was observed.

GERSDORFF (W. A.). **Toxicity to House Flies of the Pyrethrins and Cinerins, and Derivatives, in relation to chemical Structure.**—*J. econ. Ent.* **40** no. 6 pp. 878-882, 1 fig., 4 refs. Menasha, Wis., 1947.

Spray tests of the relative toxicity to house-flies (*Musca domestica*, L.) of certain constituents of pyrethrum flowers and some of their hydrogenated derivatives showed, in addition to findings already noticed [*R.A.E.*, B **37** 66-67], that pyrethrin I and cinerin I were about twice as toxic as their isodihydro derivatives, and pyrethrin I about twice as toxic as the mixture of "pyrethrins" (55 per cent. pyrethrin I and cinerin I) contained in the ordinary kerosene extract of pyrethrum used as a standard. Isodihydropyrethrin II and isodihydrocinerin II had negligible toxicity at the concentration levels of the pyrethrum standard tests, and tetrahydropyrethrin I was less than 6.25 per cent. as toxic as the pyrethrum standard. The esters formed by the same acid with the optically active and racemic forms of the same alcohol-ketone did not differ in toxicity.

McALISTER jr. (L. C.), JONES (H. A.) & MOORE (D. H.). **Piperonyl Butoxide with Pyrethrins in wettable Powders to control certain agricultural and household Insects.**—*J. econ. Ent.* **40** no. 6 pp. 906-909, 8 refs. Menasha, Wis., 1947.

Since piperonyl butoxide, which is the technical grade of (3,4 methylenedioxy-6-propylbenzyl)(butyl) diethylene glycol ether, has given excellent results as a synergist with pyrethrins in petroleum oil sprays, liquefied-gas aerosols and powders or dusts against the usual household insects and certain agricultural insects, it was employed with them in water-dispersible powders in tests in Maryland against the Japanese beetle [*Popillia japonica*, Newm.] on maize [*R.A.E.*, A **37** 299], house-flies [*Musca domestica*, L.] and flies on cattle.

The method of preparing the powders is described; diatomaceous earth was generally used as the carrier. On unfinished ply-wood panels in laboratory tests, surface deposits of 50 mg. piperonyl butoxide and 5 mg. pyrethrins per sq. ft. from a water suspension of a dispersible powder gave complete knock-down of house-flies in 30 minutes or less until the tenth week inclusive after application. After 14 weeks, knockdown was 94 per cent. in four hours. Mortality in 24 hours of flies exposed until knockdown was complete or for four hours, whichever period was less, ranged from 65 to 98 per cent. in all tests up to and including the 14th week, and was 42 per cent. after 16 weeks. The panels were stored at 80°F. and 60 per cent. relative humidity in diffused light. A water suspension of powder containing 10 per cent. piperonyl butoxide and 0.5 per cent. pyrethrins at a concentration of 24 lb. per 100 U.S. gals.

applied to cows at 1 U.S. pint per animal kept them free of horn-flies [*Siphona irritans*, L.] for three days. A spray containing only 8 lb. powder per 100 U.S. gals. applied at the same rate destroyed the original population of flies, but the cattle were reinfested the next day. Increasing the concentration to 32 lb. per 100 U.S. gals. did not increase the period of protection beyond three days. Wettable powders containing small quantities of piperonyl butoxide and pyrethrins with about one-fourth the quantity of DDT usually recommended for use alone controlled horn-flies and stable flies [*Stomoxys calcitrans*, L.] for six days, and these results were confirmed in work by C. V. Anderson in Florida. In view of the toxicity of DDT to mammals, this finding is important.

CREIGHTON (J. T.) & DENNIS (N. M.). **The Tail Louse in Florida.**—*J. econ. Ent.* **40** no. 6 pp. 911-912, 2 figs., 1 ref. Menasha, Wis., 1947.

The first recorded collection of *Haematopinus quadripertusus*, Fahrenholz, in the United States was made by the senior author in Florida in June 1944 [cf. *R.A.E.*, B **37** 117], and the species has since been found to be rather widely distributed in the State. The adult is described, and an account is given of the habits of the louse and the effect of infestation on cattle [cf. *loc. cit.*]. Nymphs and even adults were sometimes found around the eyes and on different parts of the body other than the most favoured sites. The period of greatest abundance was late summer and early autumn. Studies on control were begun in June 1945. Spraying the tails or the body but not the head with emulsions containing 5 per cent. Thanite, 2 per cent. Thanite and 0.2 per cent. DDT, or 3 per cent. DDT gave good initial control but allowed rapid reinfestation. However, thoroughly spraying all regions of the body, including the skin around the eyes, with suspensions and emulsions containing 1 and 2 per cent. DDT, or with a pyrethrin-rotenone spray containing 0.37 per cent. pyrethrin I and 0.32 per cent. derris concentrate, in an alcohol base, gave excellent control of the lice and protection from reinfestation for several weeks. It is concluded that several insecticides including DDT, Thanite, pyrethrins and rotenone will control *H. quadripertusus*, and that effective coverage is a very important factor. Two applications at an interval of 21-28 days are recommended.

MORLAN (H. B.). **Dusts containing Combinations of DDT, Sulphur, and Hydroxy Pentamethyl Flavan to control Rat Ectoparasites.**—*J. econ. Ent.* **40** no. 6 pp. 917-918, 3 refs. Menasha, Wis., 1947.

DDT, which is being extensively used against ectoparasites of rats in anti-typhus operations on account of its effectiveness against *Xenopsylla cheopis*, Roths. [cf. *R.A.E.*, B **35** 192; **36** 112], does not give much control of *Liponyssus bacoti*, Hirst, or *Polyplax spinulosa*, Burm. As both these species have transmitted murine typhus experimentally [cf. **36** 189-190, etc.], it was desirable to find substances that would control them when added to DDT dust. In August 1946, rat runs and harbourages on 15 rural premises in Georgia, where no insecticides had been used previously, were treated with one of three dusts consisting of pyrophyllite containing 10 per cent. hydroxypentamethylflavan with or without 8 per cent. DDT, or 50 per cent. sulphur with 5 per cent. DDT. All three treatments appeared to give some control of the mites and lice. Hydroxypentamethylflavan alone was useless against fleas, but the dust in which it was used with 8 per cent. DDT controlled them better than the one containing sulphur with 5 per cent. DDT. In more extensive tests in other rural areas, hydroxypentamethylflavan and sulphur were both used at concentrations of 10 per cent. in dusts containing 8 per cent. DDT, the treatments were applied in December, and 845 rats were examined over a period of nearly four months. The results indicated that the dust of sulphur

and DDT gave slightly better control of *L. bacoti* than DDT alone and that no appreciable reduction in the abundance of this mite resulted from the addition of the flavan compound to DDT dust. Neither substance gave significant control of *P. spinulosa* or reduced the effectiveness of DDT in controlling fleas.

TELFORD (H. S.). **Benzene Hexachloride to control certain Insects affecting Domestic Animals.**—*J. econ. Ent.* **40** no. 6 pp. 918-921, 1 fig. Menasha, Wis., 1947.

A brief account is given of experiments made over a period of two years in Ohio with BHC (benzene hexachloride) against Arthropods attacking livestock and poultry. Spraying the roosts and floor of a hen house with a liquid containing 0.17 per cent.  $\gamma$  isomer prepared from a wettable powder eradicated lice, including *Eomenacanthus stramineus*, Nitzsch, *Menopon gallinae*, L., and *Goniocotes gallinae*, Retz. (*hologaster*, Nitzsch), in five days and kept the hens free for three months, but this preparation was too irritating to the operator and too malodorous for practical use. Oil solutions of BHC of 1.27 and 1.55 per cent.  $\gamma$  isomer content had much less odour. They were applied to roosts with a paint brush or oil can at 1-3.3 cc. per linear foot in tests on 21 flocks comprising some 3,300 birds. In most cases, the fowls were completely freed of lice. When they were not, this was attributed to their failure to roost on treated perches. There was no sign of irritation of the birds. Spraying the roosts and cracks in walls and ceilings of a moderately infested hen house with an oil solution containing 1.27 per cent.  $\gamma$  isomer gave apparently complete control of *Dermanyssus gallinae*, Deg., in three days. Experiments on the effect on the flavour of poultry and eggs of treatment of roosts with a solution containing 1.27 per cent.  $\gamma$  isomer at 1.5 cc. per linear foot produced no evidence of tainting.

Dusts of BHC on pyrophyllite were effective against lice on cattle and pigs and *Melophagus ovinus*, L., on sheep, and 8 oz. of an emulsion containing 0.12 per cent.  $\gamma$  isomer also gave virtually complete control of *M. ovinus* on a lamb. Application of 500 cc. of a suspension containing 0.1 per cent.  $\gamma$  isomer to a sheep with badly fouled wool and a severe infestation of blowfly larvae (*Lucilia sericata*, Mg., and *Phormia regina*, Mg.) over half the posterior region of the body gave about 95 per cent. control within 24 hours. BHC showed considerable promise against *Demodex bovis*, Stiles, on cattle when used in lanolin ointments or linseed oil solutions, but water suspensions were not effective.

ALICATA (J. E.), KARTMAN (L.), NISHIDA (T.) & PALAFOX (A. L.). **Efficacy of certain Sprays in control of Lice and Mites of Chickens.**—*J. econ. Ent.* **40** no. 6 pp. 922-923, 3 refs. Menasha, Wis., 1947.

In experiments in Hawaii to determine the effectiveness of DDT sprays against fowl mites and the value of a thiocyanate alone or combined with DDT against mites and lice, hens infested with *Eomenacanthus stramineus*, Nitzsch, *Goniocotes gallinae*, Retz., *G. gigas*, Tasch., *Lipeurus caponis*, L., *Menopon gallinae*, L., and *Mégninia cubitalis*, Mégn., were sprayed with about 28 cc. each of a suspension of 1 lb. of 50 per cent. wettable DDT in 5 U.S. quarts water, 6.5 oz. Lethane B-72 [13.5 per cent.  $\beta$ ,  $\beta'$ -dithiocyanodiethyl-ether] in 1 U.S. quart water or a mixture of 1 lb. of the 50 per cent. DDT and 8 or 12 oz. Lethane B-72 in 6 U.S. quarts water. DDT alone gave effective control of the lice for at least two months and partial or complete control of the mite for at least one month, and Lethane alone gave complete control of the mite and partial or complete control of the lice for at least one month.

Sprays containing both DDT and Lethane consistently gave complete control of both lice and mite within a week and the birds were still free from infestation after a month. Untreated fowls kept in pens adjoining those that were treated remained infested.

ROSENSTIEL (R. G.). **Winter Control of *Anopheles freeborni*.**—*J. econ. Ent.* **40** no. 6 pp. 925–926, 2 refs. Menasha, Wis., 1947.

The effect on overwintering females of *Anopheles maculipennis freeborni*, Aitken, of treating buildings with DDT was tested in central California in the winter of 1944–45 and in January 1946. Populations were low at both times. In the first season, six groups of seven farms having comparatively heavy Anopheline populations were used. In each group, except the control, spray was applied on 22nd December to resting populations in 9–13 buildings, all of which had unpainted wooden walls. Sampling of the untreated population in 22 resting places showed that numbers remained constant through late December and all January but decreased rapidly between 1st and 25th February. A 98 per cent. DDT powder dissolved in diesel oil to make a 5 per cent. spray gave complete control for eight weeks when applied at 1.03 U.S. gal. per 1,000 sq. ft. (161 mg. DDT per sq. ft.). A 20 per cent. DDT wettable powder and a 13 per cent. DDT emulsion concentrate added to water and used with 1 per cent. summer oil to give a concentration of 0.03 per cent. DDT and applied at 1.03 and 0.88 U.S. gal. per 1,000 sq. ft. (1.16 and 0.99 mg. DDT per sq. ft.), respectively, gave 97.1 and 98.8 per cent. control after five weeks and 88 and 100 per cent. after eight weeks. Diesel oil alone at 1.21 U.S. gal. per 1,000 sq. ft. gave over 90 per cent. control for eight weeks. A 1 per cent. summer-oil emulsion at 1.1 U.S. gal. per 1,000 sq. ft. gave no control.

In the second season's tests, DDT dispersed as a steam-generated aerosol from concentrates containing 0.001, 0.01 and 0.1 per cent. DDT at average rates of 1.4, 12.3 and 100.9 mg. DDT per cu. ft. gave 95.3, 94 and 100 per cent. control, respectively. A fog of water alone had no effect.

TELFORD (H. S.). **Insecticides for Cattle Grub Control.**—*J. econ. Ent.* **40** no. 6 pp. 928–930. Menasha, Wis., 1947.

A summary is given of 23 trials of insecticides for the control of larvae of *Hypoderma* in cattle. They involved 94 animals, all from Ohio, and about 1,000 warbles. Dusts were applied with a shaker over the entire back of the animal and rubbed in by hand. Linseed-oil solutions were applied to the cysts only with a paint brush, and lanolin ointments were applied to the cysts by hand or with a spatula. The following conclusions are tentatively drawn from the results. The effectiveness of certain synthetic insecticides is enhanced when they are incorporated in linseed oil or lanolin or both. Chlorinated camphene (toxaphene) has little promise against *Hypoderma* larvae except possibly in high concentration in ointments or solutions. Dusts of benzene hexachloride were ineffective at 1 and 3.7 per cent.  $\gamma$  isomer content. Ointments at 0.3 and 0.9 per cent. were fair to good. Cubé dusts were more effective when the carrier was calcium carbonate than when it was fuller's earth. Solutions and ointments containing 5 per cent. chlordane showed some promise. Dusts containing 3 and 10 per cent. methoxy-DDT (Methoxychlor), screwworm smear 62 [*R.A.E.*, B **30** 195] and borax were ineffective. Three grubs treated with 25 per cent. o-nitrodiphenyl in a mixture of linseed oil and lanolin were all killed.

LINDQUIST (A. W.) & ROTH (A. R.). **Species and Incidence of Cattle Grubs in Oregon.**—*J. econ. Ent.* **40** no. 6 pp. 930–931, 2 refs. Menasha, Wis., 1947.

Observations and collections of *Hypoderma* larvae made in various parts of Oregon in 1946–47 showed that infestation is widespread in the State and the percentage of cattle affected is often high, sometimes reaching 100. Both *H. lineatum*, Vill., and *H. bovis*, Deg., occur, and this makes the season when grubs are in the backs of the animals rather long. Larvae were found there from December to the end of June. The greatest numbers were seen in late January and early February. *H. lineatum* was found alone early in the season and *H. bovis* at the end. The two species were about equally plentiful in late March.

HARTZELL (A.) & WEXLER (E.). **Histological Effects of Sesamin on the Brain and Muscles of the Housefly.**—*Contr. Boyce Thompson Inst.* **14** no. 3 pp. 123–126, 1 fig., 3 refs. Menasha, Wis., 1946.

The authors describe experiments carried out to determine whether pure sesamin applied as a spray can be detected by histological methods in the nerves and muscles of house-flies (*Musca domestica*, L.). It was compared with pyrethrum and sesame oil, alone and in combination, and with a proprietary product designated Improved Pyrin 20, which was known to contain sesame oil extractive and pyrethrum [cf. *R.A.E.*, B **34** 61]. The following is based on the authors' discussion and summary. Sesamin was found to produce characteristic effects on the brain and striated muscles in moribund house-flies in a preliminary histological study in tissues stained with Delafield's haematoxylin and eosin Y. The principal effects were the vacuolation of the larger nerve cells of the brain and the accentuation of the nodes and Krause's membrane in the striated muscles. The results obtained were, in general, similar to those from sesame oil at a high concentration, and combinations of sesamin and pyrethrum showed similar effects on the brain and muscle tissues to those of combinations of sesame oil and pyrethrum [cf. *loc. cit.*]. There is thus histological evidence that the active principle of sesame oil is sesamin. Activation appears to be due to the destruction of two tissue components, namely the fibres and nerve cells; pyrethrum destroys the fibre tracts, while sesamin causes vacuolation of the larger nerve cells. The effect of Improved Pyrin 20 is similar to the combined effect of sesamin and pyrethrum for both muscle and brain tissues, except that the former resulted in more prominent fibres showing less dissolution in the brain tissue.

PRILL (E. A.), HARTZELL (A.) & ARTHUR (J. M.). **Insecticidal Thio Ethers derived from Safrole, Isosafrole, and other Aryl Olefins.**—*Contr. Boyce Thompson Inst.* **14** no. 3 pp. 127–150, 19 refs. Menasha, Wis., 1946.

A number of insecticidal compounds discovered in the past few years, including that known as piperonyl cyclohexenone [cf. *R.A.E.*, B **37** 116], contain the 3,4-methylenedioxyphenyl radical in their molecules [cf. **34** 61; **35** 186]. Safrole, a major component in certain essential oils, is probably the most important primary natural raw material for preparing intermediates for the synthesis of more complex compounds containing this radical. It is easily isomerised into isosafrole, and this oxidised to piperonal or piperonylic acid. Both safrole and isosafrole were found to react very readily with any of a number of sulphhydryl compounds. Most of the products so formed were particularly active as insecticides against house-flies [*Musca domestica*, L.], and both these and products made with certain other aryl olefinic compounds

instead of safrole or isosafrole, most of which were relatively inactive against house-flies, were effective against certain agricultural pests [cf. A 37 307].

Although many compounds containing a 3,4-methylenedioxyphenyl radical are active insecticides or synergists with pyrethrum, it would be unwarranted to assume that its presence would impart insecticidal activity to any organic molecule. Many types of compounds containing it were prepared and tested, and although some were effective, many others were relatively inactive against house-flies [cf. also next abstract]. It appears that a methylenedioxy substituent on a benzene ring may contribute activity to a compound only if the compound also contains one or more other structural components of suitable types. Moreover, the introduction of still another structural component into an active compound of this type may either increase or reduce activity.

Several of the new compounds dealt with in this paper compared favourably with pyrethrins in toxicity when tested against house-flies by the large-group Peet-Grady method [cf. 37 5]. Products of safrole or isosafrole and mercaptans generally appeared to exhibit synergistic action when mixed with pyrethrins, and the compounds tested at higher concentrations without pyrethrins showed considerable paralysing and killing effect. The two types of compounds showed similar activity, those from isosafrole being the more effective except in a few cases. If they contained simple alkyl substituents, those with *n*-amyl or *n*-hexyl substituents were the most active. Those containing simple aryl or simple aralkyl substituents were active but not outstanding. When the substituent radical contained one or more ethereal oxygen atoms, the activity of the compounds was increased; in these cases the substituent may apparently be fairly large without causing a marked decrease in effectiveness, whereas the activity of compounds containing simple alkyl substituents began to decrease at the *n*-heptyl group. One of the most effective compounds was the product of isosafrole and 2-(2-*n*-butoxyethoxy)ethyl mercaptan. The product of safrole and the same mercaptan appeared to be only slightly less active. These two compounds were also useful when mixed with DDT and a minimum amount of pyrethrins; spray solutions containing 0.025 gm. pyrethrins and 0.1 gm. DDT per 100 ml. gave inadequate knockdown in ten minutes, but halving the amount of pyrethrins and adding a small amount of one of these compounds resulted in a more satisfactory knockdown and a higher kill, probably owing to synergistic action between the thioether and pyrethrum. Compounds of isosafrole with 2-(2-phenoxyethoxy)ethyl mercaptan or 2-benzyloxyethyl mercaptan were almost as effective, and the related compounds made with safrole were somewhat less so. It is apparent that there is synergistic action between the more active compounds and pyrethrins with regard to knockdown and kill, sprays containing 0.2 gm. or less of one of the more active compounds and only 0.025 gm. pyrethrins per 100 ml. being as effective as those containing 0.16 gm. pyrethrins per 100 ml. Comparison of active and inactive compounds showed that replacing a hydrogen of the ethyl radical by a hydroxyl or butyryloxy group nullified activity.

*N*-substituted amides of acids prepared from safrole or isosafrole and mercaptoacetic acid contributed to the knockdown and kill when mixed with pyrethrins and showed considerable paralysing and killing effect when tested alone. Compounds derived from isosafrole were no more active than those from safrole. The *N,N*-di-*n*-butylamide of the first acid appeared to be the most active compound tested. The *N*-cyclohexylamides and piperidides of both acids were also very active, and the dibutylamide and the cyclohexylamide of the first acid were successfully used as substitutes for part of the pyrethrins in fly-sprays containing DDT and pyrethrum. Esters of the two acids were relatively inactive against house-flies.

The thio di-ether prepared by the reaction of styrene and di-*n*-butyl disulphide in the presence of iodine was relatively inactive to house-flies, whereas the analogous product of isosafrole and dibutyl disulphide was fairly active.

Several thioethers derived from other aryl olefins were tested, but only the product of 2-vinylpyridine and n-octyl mercaptan was definitely effective.

In acute toxicity tests, white rats that were fed for one week exclusively on diets containing 0.2 per cent. of three of the compounds that were most effective against house-flies showed no harmful effects during this period or the following month, and it is concluded that these and closely related compounds are probably not seriously toxic to warm-blooded animals.

PRILL (E. A.) & SYNERHOLM (M. E.). **Report on some miscellaneous Methylene-dioxyphenyl Compounds tested for Synergism with Pyrethrum in Fly Sprays.**—*Contr. Boyce Thompson Inst.* **14** no. 4 pp. 221–227, 7 refs. Menasha, Wis., 1946.

The results are given of experiments with 69 organic compounds of various types, all containing the methylenedioxyphenyl group in their structures, which were found to be inactive or only moderately active against house-flies (*Musca domestica*, L.) in tests incidental to the search for active substances [cf. preceding abstract] in which they were used in solution with a low concentration of pyrethrins.

DONOHUE (E. L.) & COWLING (J.). **Chemical Control of Cattle Parasites.**—*Agric. Chem.* **3** no. 2 pp. 28–31, 74–75, 77, 2 figs., 16 refs. Baltimore, Md., 1948.

The following is based on the authors' summary. Field investigations carried out on several dairy farms in north-western New Jersey during the 1947 season indicated that good control of blood-sucking flies (*Siphona irritans*, L., *Stomoxys calcitrans*, L., and Tabanids) could be obtained by treating cattle with a spray consisting of one part of a concentrate containing 10 per cent. technical piperonyl butoxide, 1 per cent. pyrethrins and 89 per cent. solvents and emulsifiers diluted in nine parts water. Hand sprayers were used, and nozzles delivering 0.1 U.S. gal. per minute at 40 lb. pressure were found to be the most satisfactory. They gave complete coverage without run-off with 1 U.S. pint spray per animal. Five days' control followed the first application on dairy cattle, and seven days' control followed subsequent applications. Control was arbitrarily considered to be ended when 6–10 flies of any species were counted on any one animal. Doubling the amount of spray applied or the proportion of piperonyl butoxide in it did not lengthen the period of effectiveness and doubling the proportion of concentrate lengthened it only slightly.

About three minutes, including time for preparing and agitating the spray, should be allowed for treating each cow. Applications of spray to dairy cows were made in conjunction with usual daily operations, so that there was no disruption of normal routine. Beef cattle were confined in a chute for spraying. The first application remained effective for seven days on these animals, presumably because their hair was longer and they were not groomed.

No pathological conditions of any type could be found following numerous weekly applications of spray. When animals were treated weekly, welts and sores resulting from fly bites healed, and no new ones appeared. No fluctuations in milk production were noted. Treated cattle ceased to be restless. The nervousness during the first application, more pronounced among heifers and beef cattle than among older cows, disappeared with subsequent sprayings.

IMES (M.). **Sheep and Goat Lice and Methods of Control and Eradication.**—*Leaflet U.S. Dep. Agric.* no. 13 (Slightly revd. by H. E. Kemper & A. O. Foster) 8 pp., 3 figs. Washington, D.C., 1946.

This is a revised edition of a leaflet already noticed [*R.A.E.*, B **16** 135] on the lice that attack sheep and goats in the United States. The species concerned

are *Linognathus ovillus*, Neum., *L. pedalis*, Osb., and *Damalinia (Bovicola) ovis*, L., which are common on sheep, *L. stenopsis*, Burm., and *L. africanus*, Kellogg & Paine, which are widespread on goats and have been recorded from sheep, and *D. (B.) caprae*, Gurlt, *D. (B.) limbata*, Gerv., and *Holakartikos crassipes*, Rudow, on goats. The bulk of the information given is the same as in the previous edition, but fumigation is omitted from the suggested methods of treatment, and DDT, rotenone and pyrethrum are recommended for dusting and DDT and rotenone for dips. The notes on arsenical dips are omitted. A satisfactory rotenone dip can be made with 1 lb. derris or cubé powder with a rotenone content of 5 per cent. in 100 U.S. gals. water [cf. **28** 238, etc.]. All lice are killed by dipping infested animals in preparations containing 0.2 per cent. DDT [cf. **35** 28; **36** 13-14] made with wettable powders or emulsifiable stock solutions.

KOUTZ (F. R.). **The Screw-worm Fly, *Cochliomyia americana*, in Ohio.**—*J. Amer. vet. med. Ass.* **110** no. 843 p. 385, 3 refs. Chicago, Ill., 1947.

Four records are given of the finding of larvae of *Callitroga hominivorax*, Coq. (*Cochliomyia americana*, Cush. & Patt.) on cattle and a pig in Ohio in September and November 1946. These are thought to be the first recorded cases of infestation by *C. hominivorax* in the State. None of the animals concerned had been imported. Several other similarly infested wounds are known to have been treated, but the larvae from them were not examined.

HAWES (I. L.) & EISENBERG (R.). **Bibliography on Aviation and economic Entomology.**—*Bibliogr. Bull. U.S. Dep. Agric.* no. 8, iv+186 pp. Washington, D.C., 1947.

This bibliography covers 1,084 papers published during 1919-45, and includes brief descriptions or abstracts of their contents. They are arranged alphabetically by authors for each year and the subjects include the use of aircraft for applying insecticides, the question of injury by the latter to plants, bees, livestock and wildlife and to aircrews and ground personnel, the transport of insect vectors of disease, with the attendant problems of quarantine and disinfestation, aircraft studies of aerial fauna, and aerial scouting and mapping of infested areas. There is an index to subjects and authors.

BAERG (W. J.). **Introduction to applied Entomology.**—3rd edn. revd., 11×8½ ins., [1+] vii+191 pp., 208 figs., many refs., multigraph. Minneapolis, Minn., Burgess Publ. Co., 1949. Price \$3.50.

This third edition resembles the second [*R.A.E.*, B **31** 120] in general scope and arrangement, but the information on bionomics has been brought up to date where necessary and sections on recently developed insecticides and biological control have been added.

CHORLEY (J. K.). **Report of the Division of Entomology for the Year ending 31st December, 1945.**—*Rhod. agric. J.* **43** no. 6 pp. 547-562; also as *Bull. Minist. Agric. [S. Rhod.]* no. 1377, 17 pp. Salisbury, S. Rhod., 1946.

It is stated in the medical and veterinary section of this report that in the Chipinga area of the Eastern border [Metsseter District] of Southern Rhodesia, the incidence of trypanosomiasis of cattle was heavier in 1945 than in the previous year and more farms were involved [cf. *R.A.E.*, B **36** 50], though it was not nearly so severe as in 1939 [**30** 8] and succeeding years [cf. **34** 15, etc.]. Flies caught on or near the border comprised 137 examples of *Glossina pallidipes*, Aust., 13 of *G. brevipalpis*, Newst., and 17 of *G. morsitans*, Westw.,

of which 14, 9 and 1, respectively, were taken on the Rhodesian side. The position further south had deteriorated rapidly. About 600 head of cattle died of trypanosomiasis in the native area along the border from the Umselezwe river to the junction of the Sabi and Lundi rivers, a distance of about 60 miles, and it was decided to make a cattle-free and game-free belt along the border. *G. morsitans* had continued to spread westward along the south bank of the Sabi River in Portuguese East Africa and was within 20 miles of the border. One case of trypanosomiasis occurred in the Umtali commonage.

In all the northern areas covered by controlled operations for the elimination of game, satisfactory progress was made in the control and eradication of *G. morsitans*. The fly has been greatly reduced in density over some 4,000 sq. miles, in addition to the 6,000 sq. miles cleared up to 1941 [cf. 30 8, 54; 31 40; 32 24]. The situation existing in individual districts and incidental control measures taken are briefly recorded.

STEYN (J. J.). **The Effect on the Anopheline Fauna of Cultivation of Swamps in Kigezi District, Uganda.**—*E. Afr. med. J.* 23 no. 6 pp. 163-169, 2 refs. Nairobi, 1946.

About 1942, drainage operations with suitable anti-malaria precautions were instituted by the Native Administration in some of the papyrus swamps that occupy the floors of the valleys in Kigezi, a densely populated district in south-western Uganda. The local Africans extended the work without the precautions, and the additional cultivation of swamps was followed by a great increase of malaria. The investigation reported in this paper was undertaken to determine whether the increase of cultivation was responsible for the rise in malaria incidence, which preceded the return of demobilised African troops on a large scale and could not therefore be attributed to it. Adult Anophelines from huts in the affected areas and larvae from breeding places near by were found to be mostly *Anopheles christyi*, Newst. & Cart., a species formerly thought not to be domestic and not to be an important vector of malaria [cf. R.A.E., B 32 26; 34 152]. J. D. Gillett dissected females from two villages in Kigezi where a considerable number of cases of malaria had occurred and found gland infections in five (2.36 per cent.) of 212 females of this species. These 212 made up 88 per cent. of the Anophelines collected by him in huts; the others being 13 females of *A. demeilloni*, Evans, ten of *A. marshalli gibbinsi*, Evans, and six of *A. coustani*, Lav.

In the present observations, weekly collections were made from huts in one of these villages, yielding the same species in comparable proportions, and larvae were collected weekly from the beginning of March 1944 to the end of October 1945 in five representative swamp areas, in which some 150 potential or actual breeding sites were sampled. The results of the larval surveys are shown in a table. It appears from them that there was little or no difference in the frequency or density of occurrence of Anophelines in general in available breeding sites in uncultivated and cultivated swamps, but there were great differences between individual species. Larvae of *A. m. gibbinsi* formed 12.2 and 66.8 per cent. of the total Anophelines in cultivated and uncultivated swamps, respectively, and were found on 3.7 and 12.8 per cent. of the possible occasions (occasions on which there was water in the breeding place). The corresponding percentages for *A. coustani* were 13.7 and 5.2, and 4.6 and 1.9, and for *A. christyi* they were 66.9 and 18, and 16 and 5.5.

*A. christyi* generally disappears from neglected cultivated areas that revert to swamp, and avoids irrigation ditches with a dense cover of short vegetation. It breeds prolifically in cattle drinking-places and native water-holes and also in mining pits, pig-wallows and pools in paths. Cultivated swamps usually contain many more favourable breeding sites for it than untouched ones,

owing to a great increase in the amount of open water. As there were also more larvae per occasion on which any were found, and the percentage of possible occasions on which larvae were taken was also higher, it is clear that breeding is greatly increased by cultivation as practised in Kigezi district, although a greater proportion of breeding places dries up in dry weather in cultivated than uncultivated swamp. It is concluded that the cultivation is mainly responsible for the local increase in malaria.

HUNT (R.) & DAVEY (P.). **Maintenance of *Anopheles quadrimaculatus* (in the Laboratory).**—*J. trop. Med. Hyg.* **50** no. 3 pp. 53–56, 2 figs., 2 refs. London, 1947.

A description is given of a method, based on that of Heal & Pergrin [*R.A.E.*, B **37** 23], that has been found convenient and effective for rearing large numbers of *Anopheles quadrimaculatus*, Say. A colony of this Anopheline has been maintained in London for ten months, the last six by the method described. The temperature was about the same as that used by the American workers, but the relative humidity of the room where the adults were kept was maintained at 75–85 per cent., and yeast was added to the rearing pans on the sixth, seventh and eighth days of larval development.

JOHNSON (C. G.). **Lethane 384 on Clothing as a Mosquito Repellent.**—*Brit. med. J.* no. 4489 pp. 92–93. London, 1947.

In tests made in a wood in southern England in 1942, thin cotton stockings that were sprayed with a mixture of 1 part Lethane 384 [50 per cent. n-butyl carbitol thiocyanate in kerosene] and 1 part light oil after being put on gave about 80 per cent. protection or better for 5½ hours from bites of mosquitos on the legs as compared with untreated stockings; but sprayed denim overalls with the sleeves rolled up above the elbow afforded no great protection from bites on the hands and forearms, which were untreated. The total for all exposures in the latter experiment indicated some protection, but it bore no relation to time over a period of seven hours, during which controls were sometimes bitten more often than the treated subjects and sometimes less. It is concluded that Lethane 384 shows some promise in protecting parts of the body immediately under treated cloth and may be of use when dimethyl phthalate is unobtainable or its use is undesirable because of its solvent properties on plastics, etc., but it is unreliable for giving general protection by spraying all clothing. It is too irritant and toxic for direct application to the skin.

#### PAPERS NOTICED BY TITLE ONLY.

MICHENER (C. D.). **A Method of rearing Chigger Mites (Acarina, Trombiculinae).**—*Amer. J. trop. Med.* **26** no. 2 pp. 251–256, 4 figs. Baltimore, Md., 1946. [For brief account see *R.A.E.*, B **37** 61–62.]

**Liste officielle des noms français des insectes d'importance économique au Canada** [including French, English and scientific names]. (*Préparée en collaboration et publiée en supplément du rapport annuel de la Société de Québec pour la Protection des Plantes*).—66 pp. Quebec, Minist. Agric., 1947.

GUNTHER (F. A.) & TOW (L. R.). **Inhibition of the catalyzed thermal Decomposition of DDT.**—*Science* **104** no. 2696 pp. 203–204, 1 fig., 11 refs. Lancaster, Pa., 1946. [See *R.A.E.*, A **37** 285.]

GUNTHER (F. A.). **Thermal Decomposition of DDT and Benzene Hexachloride Mixtures.**—*J. econ. Ent.* **40** no. 6 pp. 874–877, 10 refs. Menasha, Wis., 1947. [See *R.A.E.*, A **37** 295.]

- HUEBNER (R. J.), STAMPS (P.) & ARMSTRONG (C.). **Rickettsialpox—a newly recognized rickettsial Disease. I. Isolation of the etiological Agent.**—*Publ. Hlth Rep.* **61** no. 45 pp. 1605–1614, 7 refs. Washington, D.C., 1946.
- GREENBERG (M.), PELLITTERI (O.), KLEIN (I. F.) & HUEBNER (R. J.). **II. Clinical Observations.**—*J. Amer. med. Ass.* **133** no. 13 pp. 901–906, 7 figs. Chicago, Ill., 1947.
- GREENBERG (M.), PELLITTERI (O. J.) & JELLISON (W. L.). **III. Epidemiology.**—*Amer. J. publ. Hlth* **37** no. 7 pp. 860–868, 1 fig., 6 refs. New York, N.Y., 1947.
- HUEBNER (R. J.), JELLISON (W. L.) & POMERANTZ (C.). **IV. Isolation of a Rickettsia apparently identical with the causative Agent of Rickettsialpox from *Allodermanyssus sanguineus*, a Rodent Mite.**—*Publ. Hlth Rep.* **61** no. 47 pp. 1677–1682, 7 refs. Washington, D.C., 1946.

In the first of these papers, an account is given of the isolation of an organism having the morphological and cultural characteristics of a rickettsia from the blood of a patient during an outbreak of a peculiar febrile disease involving more than 80 cases in a district in New York City in the summer of 1946. The disease was characterised by an initial lesion and an eruption of a vesiculo-papular type and clinically resembled chickenpox. The name rickettsialpox is proposed for it. The organism isolated (referred to as the M. K. organism) produced illness in mice and guineapigs and grew well in the yolk sacs of fertile eggs. Its behaviour in them is described. Ether-extracted yolk-sac antigens were prepared that gave a complement fixing reaction with convalescent sera drawn from typical cases. Cross reactions were also given with Rocky Mountain spotted fever, but not with endemic typhus, Q fever, tsutsugamushi disease or diseases of other groups.

Certain similarities were observed between the behaviour of the M. K. organism and that recorded for *Rickettsia rickettsi conori* (Marseilles fever), but it differed from the latter in being non-pathogenic to monkeys, and in failing to stimulate agglutinins for Proteus OX19 and OX2, except at high titres against OX19 in the sera of two of the patients.

In the fourth paper, the isolation is recorded of a rickettsia (mite strain no. 1) from a saline suspension of the tissues of mites (*Allodermanyssus sanguineus*, Hirst) and of another (mite strain no. 2) morphologically, culturally and serologically indistinguishable from it from a laboratory mouse on which a mite of the same species had fed. The mites from which the first strain was isolated were from the basement of the house in which the patient lived who provided the M. K. strain of rickettsialpox. The behaviour of the two mite strains in guineapigs, mice and chick embryos and as antigens in complement fixation tests is described. It indicated that they are identical with the M. K. strain. The fact that the M. K. strain immunised guineapigs from one of the mite strains is further evidence of this. It is considered likely that man acquires infection from the mites, probably through their bites. One of the authors developed typical rickettsialpox three weeks after engaging in work on the mites. No bite was felt, but a lesion was observed seven days before the onset of fever. The name *Rickettsia akari* is proposed for the organism.

The housing estate in which the outbreak occurred is described in the third paper, which was published later than the fourth. It is suburban and well kept, but surrounded at a distance by areas of rough grass, weeds and scrub forest. The houses, which were small blocks of flats, were well built and well kept. Inquiry showed that it was unlikely that the disease had been introduced. Mosquitos (*Culex pipiens*, L.) were breeding in one place about 200 yards away, and adults were fairly abundant in dark basements, but those tested were not infected. No ticks were found in the neighbourhood. House mice (*Mus musculus*) were abundant in the basements, incinerators and courtyards, and

mites (*A. sanguineus*) in the basements (particularly on the incinerators, which were not used regularly) and on the mice. Mammalian erythrocytes were found in engorged mites. Complement-fixing antibodies of rickettsialpox were demonstrated in sera from trapped mice, and an organism identical with the M. K. strain was recovered from one of them. There was a correlation between the number of mites found and the number of cases in the house, and several cases often occurred in one family. In a house in another part of New York where cases of disease diagnosed as atypical chickenpox had occurred for a few years past, mice and *A. sanguineus* were again found in the basement. In cases in which it was possible to obtain data on the incubation period, this was between nine and 24 days. In one, it was ten days. There was an initial lesion, presumably at the site of a bite, but no patient in the main outbreak remembered being bitten. However, two patients in other parts of New York examined subsequently both volunteered the information that they had been bitten, and they developed an initial lesion of rickettsialpox at the site of the bite, one on the same day and the other two days later. It is concluded that the destruction of mice and the prompt disposal of refuse that encourages them are important factors in control.

DUNN (J. E.), DUNN (R. C.) & SMITH (B. S.). **Skin-sensitizing Properties of DDT for the Guinea Pig.**—*Publ. Hlth Rep.* **61** no. 45 pp. 1614-1620, 7 refs. Washington, D.C., 1946.

Negative results were obtained in attempts by several methods to induce cutaneous hypersensitivity to DDT in guineapigs. Positive results in experiments reported in 1944 may have been due to impurities in the DDT used. Histopathological changes in the skin following injection of DDT in maize oil and of maize oil alone are described.

TWINN (C. R.), HOCKING (B.), McDUFFIE (W. C.) & CROSS (H. F.). **A preliminary Account of the Biting Flies at Churchill, Manitoba.**—*Canad. J. Res. (D)* **26** no. 6 pp. 334-357, 2 pls., 2 figs., 15 refs. Ottawa [1949].

The following is the authors' summary. The occurrence is recorded at Churchill, Manitoba, of 5 genera and 11 species of CULICIDAE, 2 genera and 12 species of SIMULIIDAE (3 and possibly 4 of which may be new to science), and 2 genera and 10 species of TABANIDAE. Data are presented on their habitats, life histories, habits, species association and succession, and relative abundance and distribution. Observations on the relationships of these insects to other organisms are recorded, including notes on their status as pests and their influence on human activities in the locality. Evidence is presented that female mosquitos feed on the nectar of flowers and are efficient pollinators of northern orchids. A brief general picture of the ecology of the locality is given; also details of weather conditions during the period of the survey, and some microclimate data. Illustrations from photographs showing typical habitats of many of the species dealt with are included.

VARGAS (L.). **The Black Fly, *Simulium (Eusimulium) smarti*, n. sp. (Diptera : Simuliidae), of the Onchocercotic Zone of the State of Chiapas, México.**—*P. R. J. publ. Hlth* **21** no. 4 pp. 327-331, 5 figs., 9 refs. Brattleboro, Vt., 1946. (Also in Spanish pp. 332-335.)

Descriptions are given of the adults of both sexes, pupa and cocoon of *Simulium smarti*, sp. n., from the State of Chiapas, Mexico, and Guatemala. The species has hitherto been confused with *S. mexicanum*, Bellardi. The larvae live in large numbers in fast-running streams, attached to stones.

VARELA (G.) & OLARTE (J.). **Transmission of *Salmonella enteritidis* by *Pulex irritans* and *Ctenocephalus canis*.**—*Science* **104** no. 2692 pp. 104-105, 3 refs. Lancaster, Pa., 1946.

In recent experiments in Mexico, examples of *Pulex irritans*, L., and *Ctenocephalides (Ctenocephalus) canis*, Curt., were fed on white mice into which *Salmonella enteritidis* had been injected intraperitoneally 24 hours earlier. Blood cultures made at this time were positive, and the mice showed signs of acute disease. *S. enteritidis* was isolated 24, 48 and 96 hours later by culturing samples of ground fleas. Cultures made from the faeces of the fleas 24 hours after the infective meal were negative. Fleas taken 24 or 48 hours after an infective meal, and then kept fasting for 24 hours failed to transmit any recognisable *Salmonella* infection to mice 12-14 days old on which they fed at the end of this time. In an experiment in which an attempt was made to transmit the infection to two men by the bites of infected fleas, the men developed no symptoms in a month and repeated faecal cultures remained negative. It is concluded that if infection with *S. enteritidis* is produced by the bites of fleas, it is too slight to be diagnosed either in man or young mice.

GOODHUE (L. D.). **Determination of Freon-Insolubles in Pyrethrum Extract.**—*Soap & sanit. Chem.* **23** no. 1 pp. 133, 135, 1 fig., 1 ref. New York, N.Y., 1947.

The following is substantially the author's introduction and summary. Pyrethrum extract for use in aerosol bombs should be as free as possible from substances insoluble in Freon-12 (dichlorodifluoromethane) because they interfere with the performance of the dispenser and give trouble in the manufacturing process. Their removal also removes most of the substances irritating to the nose and thus reduces the unpleasant effect that pyrethrum extract has on some people. A simple method of determining the amount of material in pyrethrum extract that is insoluble in Freon-12 and in aerosol formulations containing it is described. U.S. Army specifications for pyrethrum extract for aerosols allow only 4 per cent. material insoluble in pure Freon-12, but the amount actually found in samples examined ranged down to as little as 0.1 per cent., and the amount of material insoluble in typical aerosol formulations is generally less, ranging from 0.025 to 0.5 per cent.

EDDY (G. W.) & CARSON (N. B.). **Organic Compounds tested against Body Louse Eggs.**—*J. econ. Ent.* **41** no. 1 pp. 31-36, 3 refs. Menasha, Wis., 1948.

Between 1942 and 1945, 7,068 organic compounds were tested against eggs of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.). Most of the tests were made by dipping small pieces of cloth bearing 100-200 eggs 4-6 days old into alcoholic solutions of the test materials, allowing them to dry in the open air for about an hour, and then incubating them at 30°C. [86°F.] until all the controls had hatched. The relative humidity was about 85 per cent. Lists are given of the 215 compounds that gave complete mortality at 1 but not at 0.5 per cent., the 77 that did so at 0.5 but not at 0.25 per cent., and the 20 that did so at 0.25 per cent. In the last list, the average mortality caused in six tests with a concentration of 0.1 per cent. is also shown. The only substances that gave complete mortality at that concentration in all six tests were p-chlorophenylchloromethylsulphone (Lauseto neu) and sebaconitrile. At 0.05 per cent., they gave 96 and 93 per cent. mortality, respectively. The 20 compounds that caused complete mortality as 0.25 per cent. alcohol solutions were also tested as powders in pyrophyllite. All proved far less effective in this form. In general, but not invariably, those that were the most effective in alcohol were also the most toxic in pyrophyllite. None of the solvents used caused

any detectable mortality of eggs when tested alone. The greater kill that was usually obtained with young eggs than with older ones was attributed to the longer time available for the compounds to act rather than to differences in resistance of the two age groups. Other properties that have to be taken into account when substances are considered for use as ovicides against body lice are discussed. These include toxicity to man, duration of toxicity to motile stages and rapidity of immobilisation of motile stages [cf. *R.A.E.*, B 36 88]. Chlorphenylchloromethylsulphone was fairly toxic to lice [cf. 36 183], but many of the better ovicides were ineffective against the active stages of the louse or lethal for only a short time after application. Some of those that gave complete mortality of eggs at 0.25 per cent. knocked down lice within one hour.

BRUCE (W. G.) & BLAKESLEE (E. B.). **Factors affecting Tests with DDT Sprays to control Horn Flies.**—*J. econ. Ent.* 41 no. 1 pp. 39–42, 1 fig. Menasha, Wis., 1948.

Some of the factors that influence the effectiveness of DDT sprays against *Siphona irritans*, L., on cattle and that must be taken into account in evaluating the results of tests of such sprays are discussed, and the results are given of experiments made in Florida in 1946 in which it was shown that about 1 U.S. pint of spray will thoroughly cover an animal of average size without appreciable run-off or waste, and that a minimum of 0.25 oz. DDT per animal is needed to give practical control. This minimum is provided by 1 U.S. pint spray containing 1.5 per cent. DDT, and the deposit from such an application will kill *S. irritans* for at least three weeks, the approximate duration of the life-cycle in nature. A suspension containing 1.5 per cent. DDT (made by mixing 1 lb. of a 50 per cent. DDT powder with 4 U.S. gals. water) applied at 1–1.5 U.S. pints per animal is therefore recommended for the control of *S. irritans* on cattle in the south-eastern United States [cf. *R.A.E.*, B 37 66].

LINDUSKA (J. P.), MORTON (F. A.) & McDUFFIE (W. C.). **Tests of Materials for the Control of Chiggers on the Ground.**—*J. econ. Ent.* 41 no. 1 pp. 43–47, 5 refs. Menasha, Wis., 1948.

Data are given on the procedure followed and results obtained in preliminary tests in Florida in 1945 on the possible value of about 75 selected materials for the control of Trombiculid larvae on the ground. The dominant species was *Eutrombicula (Acariscus) masoni*, Ewing. Lists are given of upwards of 50 materials that gave at least 75 per cent. control when applied at 100 lb. toxicant per acre as dusts or in solution as sprays to plots 0.001 acre in area, showing the percentage reduction in population 1, 4, 8 and 12 days after application. Preparations of 19 materials gave 90 per cent. control or more on at least one of these days. Additional tests of the more promising ones at dosages of 25 and 50 lb. per acre showed crude benzene hexachloride (about 12 per cent.  $\gamma$  isomer) in talc to be the most effective. Valone (2-isovaleryl-1,3-indandione) and pentachlorophenol, both in talc, also gave almost complete control when applied at a dosage equivalent to 25 lb. pure material per acre. Sulphur and DDT were considerably less effective than many other compounds tested. The former was very variable in its performance. Materials tested both as dusts and sprays appeared to be somewhat more effective as dusts.

FRYER (H. C.), ATKESON (F. W.) & SMITH (R. C.). **Comparison of Methods for testing Repellent-type Fly Sprays.**—*J. econ. Ent.* 41 no. 1 pp. 80–88, 5 refs. Menasha, Wis., 1948.

The following is based on the authors' summary and conclusions. A report is given of a critical comparison made in Kansas in 1942 of the whole-cow

method of carrying out field tests of repellent sprays against flies on cattle, in which the available cattle are divided into groups equal in number and approximately equal in attractiveness [R.A.E., B 31 196], and the half-cow method [cf. 31 197], in which two sprays to be compared are applied to the same cow, one on each side. The studies involved 2,592 counts of flies on cows during each of two 18-day series of tests of the half-cow type and 1,260 counts during each of the two 21-day series of tests under the whole-cow technique. The counts were distributed throughout each day of the trials by five counting periods for the whole-cow research and six for the half-cow tests. The extra counting time was given in the latter tests because it was desired to gain additional information about the half-cow method. Latin squares were used in the whole-cow tests and a symmetrical pairs design in the half-cow procedure. Latin squares were used in conjunction with the symmetrical pairs design because it was thought to be desirable to test every spray against every other spray for a period on every cow in the tests.

It is concluded that the whole-cow method is satisfactory and definitely superior to the half-cow procedure, which appears to be rendered almost useless by interference between the two sprays on the one cow. It is suggested that the whole-cow procedure should include a preliminary period during which evidence is obtained regarding susceptibility and the interval that it is desirable to leave between treatment and the beginning of counting in order to avoid a preponderance of zero counts during the early counting periods. Zero counts adversely affect statistical distributions and provide poor measurements of the relative effectiveness of a spray. The cows to be used can be divided into groups of three or more on the basis of the preliminary observations. A latin square design should be used to determine how the sprays are to be rotated. Counts of the numbers of flies on each cow of each group should be made at intervals throughout each period designated in the plan for the experiment, and the counts must be transformed mathematically into measurements of repellency that conform approximately to a normal frequency distribution. It seems likely that the logarithmic transformation  $Y = \log_e (X+1)$  will be satisfactory if large numbers of zero counts have been avoided, but statistical analysis is necessary before a final decision on this matter is reached. When the transformed measurements have been obtained, the data are examined statistically.

It is believed that the same general procedure can be adapted for critical field tests of toxicants. The potency of an insecticide such as DDT is so great when compared with the older sprays that the superiority of a sufficiently strong mixture in keeping flies off cows is obvious without careful numerical measurement, but to assess the beneficial effects of sprays in terms of milk and beef production, careful treatment of data is necessary. The sprayed and control groups of cattle must have been wholly comparable before spraying as shown by specific numerical measurements, and if the production of the sprayed animals is higher than that of the unsprayed, it may be necessary to evaluate the minimum average gain due to spraying so that it can be compared with the cost of the spray. Hence, it appears that statistical procedures are as necessary in such investigations as in the evaluation of repellents. The general statistical methods suggested in this paper apply to any critical experiments in which it is necessary to make a careful analysis of numerical measurements before valid conclusions can be drawn.

THURMAN jr. (D. C.) & BRANCH (N.). **United States Records of *Typhlodromus mariposus* (Fox) from Rats in Florida.**—*J. econ. Ent.* 41 no. 1 p. 102, 1 ref. Menasha, Wis., 1948.

Records are given of the finding on rats, *Mus (Rattus) norvegicus*, in Florida in 1946 of a mite that was identified by I. Fox as a species recently described

by him from rats in Porto Rico as *Borinquolaelaps mariposus*, gen. et sp. n. [the type of *Borinquolaelaps* being another new species]. The authors, however, transfer *B. mariposus* to *Typhlodromus* because E. W. Baker (*in lit.*) has informed them that it belongs to that genus. Baker also wrote that the mites of the genus *Typhlodromus* are free-living predators and have never been found to be true parasites.

KOHL (G. M.) & PARKER (R. R.). **Occurrence of the Brown Dog Tick in the western States.**—*J. econ. Ent.* **41** no. 1 p. 102, 1 ref. Menasha, Wis., 1948.

According to Bishopp & Trembly [*R.A.E.*, B **34** 65], *Rhipicephalus sanguineus*, Latr., was known to occur in the United States in practically all the eastern and central States and in Washington, California, Arizona and Colorado in the west. In this note, records are given of its occurrence on dogs in Montana in 1947, in Utah in 1943 and in Nevada in 1946, and in a house at Casper, Wyoming, in 1938.

BATTE (E. G.) & TURK (R. D.). **Toxicity of some synthetic Insecticides to Dogs.**—*J. econ. Ent.* **41** no. 1 pp. 102–103, 2 refs. Menasha, Wis., 1948.

The results are given of experiments on the toxicity to dogs of single doses of BHC (benzene hexachloride), toxaphene and chlordan (formerly known as chlordan) administered with oil in gelatin capsules. BHC was given as a wettable preparation containing 6 per cent.  $\gamma$  isomer at doses of 5–75 mg.  $\gamma$  isomer per kg. body weight and as a technical preparation containing 33–36 per cent.  $\gamma$  isomer at doses of 100–400 mg.  $\gamma$  isomer per kg. No toxic effect was seen in nine of 12 dogs, and the other three, which received doses of 60, 75 and 300 mg.  $\gamma$  isomer per kg. showed only slight symptoms of poisoning. It is concluded that BHC is safe to use on dogs in the concentrations usually recommended. Toxaphene caused convulsions at the lowest dosage given (20 mg. per kg.) and death at 50 mg. per kg. and all higher doses. Chlordan was relatively safe though the animals varied in their susceptibility to it. A dose of 200 mg. per kg. produced convulsions in one, while 700 mg. per kg. had little effect on another.

GUNDERSON (H.). **Range of Northern Cattle Grub in Iowa.**—*J. econ. Ent.* **41** no. 1 pp. 103–104. Menasha, Wis., 1948.

In Iowa, both the northern cattle grub (*Hypoderma bovis*, Deg.) and the southern cattle grub (*H. lineatum*, Vill.) may be found in the same area, sometimes in the same cattle. To help determine the southern limits of the former in the United States, a survey was begun in Iowa about 10th May 1947 in all but the two northernmost tiers of counties, in which the species was already known to be present, and it is concluded from the results that *H. bovis* is present throughout the State. The intensity of infestation is not well known but appears to be greatest in the northern two-thirds of the State.

BLAKESLEE (E. B.) & BRUCE (W. G.). **DDT to control the Cattle Tick—preliminary Tests.**—*J. econ. Ent.* **41** no. 1 pp. 104–105. Menasha, Wis., 1948.

In May and June 1946, preliminary tests were carried out on the effectiveness of DDT against *Boophilus annulatus microplus*, Can., in a small area north of Lake Okeechobee, in southern Florida, where this tick had recently reappeared. They were arranged so as to interfere as little as possible with the official cattle-tick eradication measures of dipping cattle at intervals of 14 days in a dip containing 0.19 per cent. arsenious oxide, and removing cattle, horses and

mules from heavily infested pastures for 8-9 months to starve the larvae. The arsenical dips have many objectionable features and are ineffective against several other ectoparasites of cattle that would be controlled by DDT. Spraying a heavily infested 50-acre pasture from which cattle had recently been removed with an emulsified solution containing 20 per cent. DDT applied from an aeroplane at about 2 lb. DDT per acre caused more than 90 per cent. mortality of larvae. It is difficult to estimate the practical value of this degree of control in an eradication programme. The character of the ground cover made little difference to the results.

The most significant feature of an experiment in which a few dairy cows released from compulsory arsenical dipping were sprayed with suspensions of DDT prepared from a water-dispersible powder at the rate of 1 U.S. gal. per animal was the apparent build-up of protection from repeated applications. Cows sprayed with 0.5 or 1 per cent. suspensions were free of ticks for seven days after the first application but had become reinfested after 14 days. However, after the third application of the 0.5 per cent. spray and the second of the 1 per cent. concentration, they remained free for about 14 days. Two cows previously infested with larvae, nymphs and adults still bore nymphs and adults seven days after spraying with 0.75 per cent. DDT, but they remained free of infestation for 14 days after a second treatment. In the course of the tests, arsenical burns on the animals' skin healed completely. When similar sprays were tested on beef cattle that were subsequently allowed to graze on heavily infested pasture with others that had been through an arsenical dip, the results were in general consistent with those obtained on dairy cattle. In one set of tests, nine out of 17 animals sprayed with 1 per cent. DDT were free of ticks when examined 14 days later, five were infested with larvae, three with nymphs and none with adults, while of 16 animals passed through the arsenical dip, seven were free of ticks, five were infested with larvae only, four with nymphs and none with adults. In comparative laboratory tests in which detached partly engorged female ticks were immersed for 30 seconds, the arsenical dip appeared somewhat more effective than DDT at various concentrations, although some eggs were laid by both lots of females. However, eggs laid by females dipped in arsenical solution failed to hatch, whereas small numbers of those laid by females dipped in DDT hatched in several instances. The results are considered encouraging.

WINGO (C. W.) & CRISLER (O. S.). **Effect of DDT on Dairy Cattle and Milk.**—*J. econ. Ent.* **41** no. 1 pp. 105-106, 2 refs. Menasha, Wis., 1948.

An account is given of tests in Missouri in which dairy cows were given daily doses of DDT approximating those they might ingest when eating dusted forage or licking themselves or other animals [*cf. R.A.E.*, B **36** 105-106] after being sprayed for the control of flies. Technical DDT was administered to the two test animals by means of capsule and balling gun each day except the four Sundays for 29 days, and they received the standard ration of dairy mash and lucerne hay and were milked once a day. Samples from each day's milking were tested for DDT against house-flies [*Musca domestica*, L.], and the cows were observed for clinical symptoms of DDT poisoning or other abnormalities each day. No symptoms of acute poisoning were evident, but the cows became slightly nervous and showed stiffness in the hind quarters during the first week. Milk production was halved at the end of the experiment, but this may have been due to the change from two milkings a day to one.

Milk from the cow that received a daily dose of 20 gm. DDT (an average of 43 mg. DDT per kg. body weight) for 25 days showed high toxicity 24 hours after the initial dose was administered, and this persisted for nine days, after which the toxicity of the milk to the flies varied from day to day, indicating

that excretion of DDT through the milk fluctuated markedly. Ten days after the last dose, the milk ceased to be significantly toxic. Milk from the cow that received 5 gm. DDT (12.2 mg. per kg. body weight) per day failed to show high toxicity to test flies except on the eighth day. After 24 days the daily dose was increased to 40 gm. (97 mg. per kg.) for four out of five days, and the milk became highly toxic within 24 hours and remained so for three days. Fifteen days after the last dose was administered, the milk ceased to be toxic to the test flies.

FURMAN (D. P.) & HOSKINS (W. M.). **Benzene Hexachloride in Cream from Cows' Milk.**—*J. econ. Ent.* **41** no. 1 pp. 106–107, 3 refs. Menasha, Wis., 1948.

As BHC (benzene hexachloride) is being increasingly used as an insecticide on domestic animals and is apparently able to penetrate the skin of mice from an aqueous suspension [*cf. R.A.E.*, B **37** 113], it was desired to find whether the use of such a suspension on cows would contaminate the milk. Two lactating cows were treated with a drenching spray of 0.5 per cent. technical BHC in aqueous suspension, one being prevented from licking itself afterwards and the other not, and a third was fed with 40 mg. technical BHC per kg. body weight in capsules. A commercial mixture composed of 50 per cent. technical BHC (12 per cent.  $\gamma$  isomer) and 0.75 per cent. sodium lauryl sulphate in inert diluents was used to prepare the spray and capsules.

BHC is difficult to analyse chemically, and cream from the milk of the treated animals was therefore subjected to a bio-assay and its content of  $\gamma$  BHC estimated by comparing the mortality of house-flies [*Musca domestica*, L.] exposed to a residue from it with reference mortality curves obtained by two methods. By the first, acetone solutions of technical BHC containing known amounts of  $\gamma$  isomer were placed in shell vials and evaporated and the vials kept at 70°C. [165°F.] for five minutes to remove all solvent. Flies reared by a standard procedure were then exposed to the residues. By the second method, 1 ml. cream was added to known amounts of  $\gamma$  BHC in chloroform, the mixture subjected to a fat-extraction process [*cf. A* **36** 393], and the residue evaporated and tested on flies as before. In the case of milk from the treated cows, 1-ml. samples of the cream were added to chloroform and treated according to the second method, and their  $\gamma$  BHC equivalent, as represented by fly mortality, estimated from the curves. In general, the two curves gave comparable results, and it was thought that most of the  $\gamma$  BHC was recovered from the cream. After the work was completed, it was found that there is a loss of toxic substance when residues of an acetone or chloroform solution of pure  $\gamma$  BHC are heated at 70°C. for five minutes, so that there was probably some loss when the experimental residues were heated in this manner. The contents of  $\gamma$  BHC obtained by comparison with the second curve are likely to be the more accurate, since the materials were subjected to similar treatments. Estimates of the odour of the vials as they were taken from the oven agreed closely with the  $\gamma$  BHC equivalents of the samples.

The  $\gamma$  BHC equivalent of the cream in parts per million by the first and (in brackets) second methods were 1.4 (3.2), 0 (0) and about 0.2 (1) for the first cow (licking prevented) 2, 5 and 9 days after treatment, 4.4 (5.5), 2.5 (4.2), 0.4 (1.5) and 0 (0) for the other sprayed cow after 1, 2, 5 and 11 days, and 2.4 (4.2), 0.6 (2) and 0 (0) for the third cow after 1, 5 and 11 days.

The presence of almost as much  $\gamma$  BHC in the cream of the cow that was prevented from licking itself as in that of the others showed that absorption must have taken place through the skin. Since milk containing a detectable quantity of BHC could be classified in the United States as an adulterated food, and since very small quantities in the cream produce a musty odour, it is

considered inadvisable to spray or dip dairy cattle there with aqueous suspensions of BHC unless the milk obtained for at least a week after treatment is used for other than human consumption.

RITCHER (P. O.) & INSKO jr. (W. M.). **Control of the Northern Fowl Mite.**—*J. econ. Ent.* **41** no. 1 pp. 123–124. Menasha, Wis., 1948.

Laboratory studies and field tests in which acaricides were applied to fowls for the control of heavy natural infestations of *Liponyssus sylviarum*, C. & F., at the Kentucky Agricultural Experiment Station in 1947 showed that 2–4 drops of 40 per cent. nicotine sulphate per bird were very effective in giving control over a considerable period (1–2 months), whereas sodium-fluoride powder, and powders containing 5 per cent. DDT, 10 per cent. sabadilla, 0.5 per cent.  $\gamma$  benzene hexachloride or a proprietary thiocyanate preparation gave some initial relief but were effective for only a very short time.

GERBERICH (J. B.). **Rearing House-flies on common Bacteriological Media.**—*J. econ. Ent.* **41** no. 1 pp. 125–126, 7 refs. Menasha, Wis., 1948.

Research involving the need for rearing larvae of house-flies [*Musca domestica*, L.] in association with specific bacteria led to a study to determine which of the commoner bacteriological media can be used to rear them. The experiments were carried out at room temperature (70–74°F.). The 35 media chosen were prepared and sterilised as for bacteriological studies, and 15 cc. of a given one (enough to support ten larvae) was poured into a sterile petri dish and allowed to stand for six hours, after which time 10–20 eggs were placed on it. When there were more than ten larvae in one dish, cannibalism often occurred. The surplus moisture that formed upon the lid of the dish was removed when the eggs were introduced, and the lids were raised daily to prevent them from sticking to the dishes and thereby preventing the circulation of air. Aseptic conditions were not maintained, as the maggots did not develop or grow on sterile media. If such conditions were desired to prevent contamination of a culture, they could be obtained by rapidly washing the eggs in a mixture of equal parts of absolute alcohol and a 0.1 per cent. solution of mercuric chloride and following the fundamental bacteriological practices for rearing pure cultures.

Only 16 of the 35 media (a list of which is given) showed any promise, and only 10 were dependable. The 16 all had an agar base and were rich in simple carbohydrates and proteins, and the best was beef lactose agar. The digestive enzymes of the maggots liquefied gelatins, and the larvae drowned in liquid gelatins and broths unless these were absorbed in a mechanical agent such as paper. Eggs generally hatched 24–36 hours after coming into contact with the media. The larval stage lasted 10–15 days and the pupal period several days. The life-cycle was about 10 days longer than with a medium of bran and lucerne. For oviposition, the flies were put in a 500 cc. flask containing 2 ins. beef lactose agar and plugged with cotton-wool. A stimulant was necessary [*cf. R.A.E.*, B **6** 67], the best one tried being three drops of 2 per cent. glacial acetic acid per flask, applied on cotton-wool. The plugs were removed and the jars aired as soon as oviposition had occurred, and the flies were transferred to a rearing cage for further study and the eggs to agar plates.

MACKERRAS (M. J.) & LEMERLE (T. H.). **Laboratory Breeding of *Anopheles punctulatus punctulatus*, Dönitz.**—*Bull. ent. Res.* **40** pt. 1 pp. 27–41, 7 figs., 11 refs. London, 1949.

The following is based on the authors' summary of this account of methods developed for rearing *Anopheles punctulatus*, Dön., in Australia in large numbers

for work on the chemotherapy of experimentally transmitted malaria, and of observations on its behaviour in captivity. The room used for housing the colony is described. Its main features were an insulation system to enable temperature to be controlled to some extent during winter and eight windows to ensure good natural lighting. The adults were kept in breeding cages that were large enough (3 ft. high and 2 ft. square) to allow them to manoeuvre during pairing and oviposition and were designed to ensure high humidity while exposing them to daily fluctuations in light intensity. Provision was made for easy access to the interior for feeding and general management. Larvae were kept throughout their development in separate batches, representing daily age groups. During the three days after they hatched, they were left in the dishes containing soil and water in which the eggs were laid. After this, they were reared in shallow glass dishes. They were fed at intervals throughout the day with Farex, a proprietary infant food containing 75 per cent. carbohydrate, 14 per cent. protein, 3 per cent. fat, 4 per cent. minerals and 4 per cent. moisture. Pupae were washed and put together in small enamel dishes at the rate of 150 per sq. inch. The first pupae formed in each batch contained a high proportion of males and were returned to the breeding cages. Those formed later contained a high proportion of females and were placed in small cages, in which the adults were kept for infection with malaria.

A diurnal rhythm of adult activity was observed. Biting normally occurred at night. Pairing took place at twilight, while the insects were in flight. Eggs matured in 72 hours after the first blood-meal and in 48 hours after subsequent blood-meals. Oviposition began soon after twilight, the eggs being scattered while the females performed a hovering dance over the water surface. Water containing soil was preferred for oviposition. Eggs could withstand drying for at least 5½ days. Developmental periods observed were 42 hours for eggs, 5–8 days for larvae and 30–40 hours for pupae. Factors favouring larval development were shallow water, a muddy or sandy substratum, liberal food and a water temperature between 30 and 35°C. [86 and 95°F.]. The period for which 50 per cent. of the adults survived in the breeding cages was about 15 days.

MOGGRIDGE (J. Y.). *Glossina pallidipes* and open Country in the coastal Area of Kenya.—*Bull. ent. Res.* **40** pt. 1 pp. 43–47, 1 fig., 2 refs. London, 1949.

Observations on the extent to which *Glossina pallidipes*, Aust., will enter and cross open country were made in the coastal area of Kenya near Kilifi, along the edge of a thicket in which populations of this species and *G. austeni*, Newst., were large and *G. brevipalpis*, Newst., was also present. In 13 experiments in the dry season of 1935, in which a catching party with two screens moved twice along paths 350 yards long at distances of 25, 50, 100 and 125 yards from the edge of the thicket, 52, 13, 7 and 2 individuals of *G. pallidipes*, respectively, and no example of the other species, were caught. In 15 similar experiments in the wet season of 1939, catching parties with oxen as bait moving along paths 400 yards long 80, 180, 230 and 280 yards from the thicket took 35, 12, 10 and 2 individuals of *G. pallidipes*. One male of *G. brevipalpis* was caught 80 yards from the thicket. The results for *G. pallidipes* are compared with those obtained with *G. swynnertoni*, Aust., in Tanganyika [*R.A.E.*, B **25** 38]. In other experiments in the wet season of 1939, made to determine whether fly would follow natives into the open or be carried by them from the thicket edge, five adults of *G. pallidipes*, one of *G. austeni* and one of *G. brevipalpis* carried out of the thicket by men alone flew away, engorged, when they were still less than 150 yards from it. In seven experiments in which the men carried firewood or bundles of grass, only two females of *G. pallidipes* were carried out and these flew off gorged within

100 yards of the thicket edge [*cf.* 25 40]. When the men bore no loads but were accompanied by an ox, three individuals of *G. pallidipes* were carried from the thicket with the cattle for 200 yards. In three sections of a fly round, passing, respectively, through a clump of thicket, between the clump and the main thicket 16 yards distant and close to the open side of the clump, the numbers of *G. pallidipes* taken per 500 yards were 27, 4 and 11 and the percentages of females 28·9, 58·2 and 41·3, respectively. Thus, the catch was very low only eight yards from two heavily infested thicket areas. However, when a party stayed in the glade between the thicket areas for a short time, it made a much larger catch. It is therefore not safe to use fly-round data to predict tsetse behaviour under circumstances other than those pertaining to fly rounds.

McARTHUR (J.). **A new Variety of *Anopheles aitkeni* from Borneo.**—*Bull. ent. Res.* 40 pt. 1 pp. 49–52, 2 figs., 3 refs. London, 1949.

Descriptions are given of adults and larvae of *Anopheles aitkeni* var. *borneensis*, n., from North Borneo. The larvae were taken in clear running water under dense jungle shade in the hills surrounding Tambunan Plain in December 1941, and the adults were reared in the laboratory. The adults are apparently indistinguishable from other varieties except by the male terminalia and possibly by the greater length of the proboscis, but the larvae show considerable differences from the known varieties, especially in the multiple branching of the clypeal hairs.

McARTHUR (J.). **The *Anopheles* of Tambunan, North Borneo.**—*Bull. ent. Res.* 40 pt. 1 pp. 53–60, 6 refs. London, 1949.

Brief accounts are given of the habits of larvae and adults and the importance of the species of *Anopheles* found during a survey of the plain of Tambunan, North Borneo, in 1939–42, as a result of which the local vector of malaria was shown to be *Anopheles leucosphyrus*, Dön. [*R.A.E.*, B 36 203]. Of nearly 48,000 larvae identified, about 56, 17, 15 and 11 per cent., respectively, were *A. barbirostris*, Wulp, *A. kochi*, Dön., *A. maculatus*, Theo., and *A. philippinensis*, Ludl., and the remainder comprised *A. karwari*, James, *A. aitkeni aitkeni*, James, *A. a. bengalensis*, Puri, *A. a. borneensis*, McArthur [see preceding abstract], *A. a. palmatus*, Rodenw., *A. leucosphyrus*, Dön., *A. barbumbrosus*, Strickl. & Chowd., and *A. tessellatus*, Theo. All these species except *A. aitkeni* in any of its forms and with the addition of one individual of *A. ludlowi*, Theo., were taken as adults. *A. leucosphyrus* bred in dense jungle, where the larvae were found in seepages containing dead leaves and sometimes in hoof-prints. They remained submerged for a long time when disturbed. *A. maculatus* bred in clear, spring water in sunlight. Adults were not often seen. The number of adults of *A. barbirostris* found was comparatively small. This species bred in the rice-fields and in pools, wells, swamps, seepages and streams, and appeared to prefer vegetation or a certain amount of pollution in the water. The larvae were found amongst grasses fringing pools in full sunlight and were easy to see and catch.

SABROSKY (C. W.). **On the Distribution and correct Name of *Oscinis pallipes*, the Swarming Gnat of the Sudan.**—*Bull. ent. Res.* 40 pt. 1 pp. 61–62. London, 1949.

The author concludes that *Oscinella sziládyi* var. *aharonii*, Duda, described from Palestine, is specifically distinct from *O. sziládyi*, Duda, described and known only from Bulgaria, and that *O. aharonii* is the species described from the Sudan by Lamb as *Oscinis pallipes* [*R.A.E.*, B 11 87], a name preoccupied by

*Hippelates (Oscinis) pallipes*, Lw. He has received specimens of *Oscinella aharonii* from the Punjab, Iraq, Egypt and the Sudan, almost always accompanied by the information that they were swarming in houses. He gives a key distinguishing *O. aharonii*, *O. sziládyi*, and *Siphunculina funicola*, de Meij., the common eye fly of India and the Orient [27 206], which superficially resembles them.

WHITESIDE (E. F.). **An Experiment in Control of Tsetse with DDT-treated Oxen.**—*Bull. ent. Res.* 40 pt. 1 pp. 123–134, 2 figs., 17 refs. London, 1949.

The following is substantially the author's summary. An experiment to ascertain whether extermination of *Glossina pallidipes*, Aust., could be brought about by introducing large numbers of oxen treated with DDT into its habitat was carried out in a small isolated block of bush in Tanganyika. The oxen were sprayed with a solution of 9 per cent. w/v p,p'DDT and 9 per cent. w/v resin in groundnut oil. It was estimated that when they were sprayed once weekly, about 70 per cent. of the tsetses settling on them were killed, and when they were sprayed twice weekly, about 95 per cent. were killed. Enough treated oxen were introduced into the bush to outnumber the larger game by about 6 to 1, but they were fewer than the small game.

After three months in which oxen sprayed once weekly were herded in tens in the bush for ten hours each day, the population of female tsetses was reduced by about 70 per cent. After a further two months in which oxen sprayed twice weekly were herded in fives, a reduction of 80 per cent. amongst the survivors was brought about. It was calculated that if these rates of decline could be maintained, extermination would take 22 months under the former conditions, and about nine months under the latter. There are reasons, however, for supposing that destruction might take place more slowly as extermination was approached. It was shown that unless such a measure as this proceeds to extermination, it may be largely wasted, for the tsetse population was restored to its original numbers in a relatively short time. The conditions governing the success of this type of measure are discussed. Reasons are given for supposing that quicker destruction of *G. pallidipes* is unlikely to be economically attained; on the other hand, greater success might well be achieved against *G. morsitans*, Westw., or *G. swynnertonii*, Aust.

MATTINGLY (P. F.). **Studies on West African Forest Mosquitos.—Part I. The seasonal Distribution, Biting Cycle and vertical Distribution of four of the principal Species.**—*Bull. ent. Res.* 40 pt. 1 pp. 149–168, 6 figs., 8 refs. London, 1949.

The following is almost entirely based on the author's summary. This paper is the first of two on the seasonal distribution, hourly variation in biting activity, and vertical distribution of certain Nigerian mosquitos in swamp forest on the left bank of the Ogun river about three miles upstream from Lagos lagoon. The technique employed in the studies resembled that used by Haddow in Uganda [*R.A.E.*, B 35 67]. Human bait was used in both cases, and the agreement between the results in the two localities justifies the employment of such methods. Over 50 species of mosquitos were taken in all, and 14 of these proved to be sufficiently abundant to yield significant figures. Four of them are discussed, and the remainder will be dealt with in the second paper. The one referred to as *Anopheles gambiae*, Giles, probably included a high proportion of *A. melas*, Theo., since all of 12 females that oviposited laid *melas* eggs [cf. 36 97].

The most remarkable feature of the seasonal distribution was the very restricted period during which *A. gambiae* was present in any abundance. It occurred in large numbers only during the heavy rains of June and July,

increased to a less extent in association with the small rains of September–October, and almost disappeared during the dry season. *Aedes africanus*, Theo., showed a similar seasonal distribution, but *Mansonia* (*Taeniorhynchus*) *africana*, Theo., and *Anopheles hargreavesi*, Evans, were most numerous during the dry season. In the area under consideration, *A. hargreavesi* may well be a more important vector of malaria than *A. gambiae*, owing to its greater abundance and more uniform seasonal distribution.

As in Uganda, *Aedes africanus* proved to be mainly a tree-top biter with a well-marked peak period of biting activity associated with evening twilight, whilst *Anopheles gambiae* and *A. hargreavesi* bit mainly on the ground and had their peak period in the morning. The biting cycle (hourly variation in biting activity) of *A. hargreavesi* showed considerable differences from that of *A. gambiae* when the combined figures for all levels were considered, but when the records for ground level only were plotted for *A. hargreavesi*, the curve very closely resembled that for *A. gambiae*. This is thought to be due to the fact that the peak biting period of *A. hargreavesi* was about one hour later than that of *A. gambiae* and is delayed until after sunrise, so that it occurs at a time when biting on the upper platforms has been much reduced. Thus, these platforms do not contribute much to the peak figure, and the peak as a whole is lowered. The occurrence of peak activity in the early morning in *A. gambiae* may have an important bearing on personal precautions against malaria.

The biting cycle of *M. africana* differed from that of any other species studied in that the period of peak activity occurred during the middle part of the night, the exact time varying quite widely on the various occasions on which observations were made. It is suggested that this may have been due to the occurrence of both morning and evening peak periods within the same species.

Details are given of the variations in temperature and humidity encountered during the experiments, together with meteorological observations made at a neighbouring airfield, but a full discussion of the relation of these factors to the activity of the mosquitos is reserved for the second paper.

ROMAÑA (C.) & GIL (J.). **Xenodiagnóstico artificial.**—*An. Inst. Med. reg.* **2** no. 1 pp. 57–60, 1 fig., 1 ref. Tucumán, 1947. (With Summaries in English and French.)

Xenodiagnosis is one of the most reliable methods of detecting *Trypanosoma* (*Schizotrypanum*) *cruzi*, the causal agent of Chagas' disease, in man [*cf.* R.A.E., B **34** 21], but it is not always possible to arrange for the Triatomine bugs to feed directly on the patients. An artificial method of obtaining the same result in such instances is here described. The defibrinated or citrated blood of the suspected case is placed in a tube covered with the skin of a laboratory animal (guineapig or mouse), and the covered end is inserted into another tube containing 5–6 bugs and a strip of filter paper leading up to the skin. The tube is kept for an hour at 37°C. [98.6°F.], during which the bugs feed through the skin, and they are examined in the ordinary way a month or two later.

ALVARADO (C. A.) & HEREDIA (R. L.). **Observaciones sobre una nueva variedad del *Anopheles* (*A.*) *pseudopunctipennis* Theobald 1901, encontrada en la provincia de Tucumán. (Nota previa.)** [Observations on a new Variety of *A. pseudopunctipennis* found in the Province of Tucumán (preliminary Note).]—*An. Inst. Med. reg.* **2** no. 1 pp. 73–78, 6 figs., 1 ref. Tucumán, 1947. (With Summaries in English and French.)

Eggs laid by females of *Anopheles pseudopunctipennis*, Theo., taken in Tucumán, Argentina, differed from those of the four recognised varieties of this

species [cf. *R.A.E.*, B **36** 53] and are considered to belong to a new variety, for which the name *patersoni* is proposed. The eggs are briefly described, and figures are given of those of the five varieties, as well as microphotographs of *patersoni*, *franciscanus*, McCracken, and *typicus*, which are the three found in Tucumán.

ROMAÑA (C.) & ABALOS (J.). *Triatoma delpontei* n. sp. (Hemiptera, Reduviidae).—*An. Inst. Med. reg.* **2** no. 1 pp. 79–93, 2 col. pls., 7 figs., 14 refs. Tucumán, 1947. (With Summaries in English and French.)

Descriptions are given of all stages of *Triatoma delpontei*, sp.n., adults of which were found in the nests of a bird (*Myiopsitta*) in several Provinces of Argentina in 1943–45, together with characters distinguishing it from *T. platensis*, Neiva. One batch was found to be infected by *Trypanosoma* (*Schizotrypanum*) *cruzi*. The bug was reared in the laboratory on pigeon and guineapig, and has been successfully used in xenodiagnosis of *T. cruzi*.

GALINDO (P.). *Anopheles xelajuensis* DeLeon, a new Addition to the known Anopheline Fauna of Panama.—*Pan-Pacif. Ent.* **23** no. 1 p. 44. San Francisco, Calif., 1947.

*Anopheles xelajuensis*, De León, has been recorded only from Guatemala and Mexico [*R.A.E.*, B **31** 21, 51, 214]. In May 1946, however, six males and four females were taken resting in hollow trees in the Chiriqui Volcano region, Panama, at an elevation of 6,200 ft., and T. H. G. Aitken had collected larvae of the species in the same general area some years before.

BATES (M.). The Development and Longevity of *Haemagogus* Mosquitoes under Laboratory Conditions.—*Ann. ent. Soc. Amer.* **40** no. 1 pp. 1–12, 24 refs. Columbus, Ohio, 1947.

An account is given of laboratory experiments in Villavicencio, Colombia, with the local form (subsp. *falco*, Kumm, Osorno & Boshell) of *Haemagogus spegazzinii*, Brèthes [cf. *R.A.E.*, B **37** 26]. The material consisted of adults caught in the forest and their  $F_1$  offspring, since *falco* will not pair under cage conditions. The following is substantially the author's summary of the results.

The effect of food and temperature on the development of the larvae was investigated. Brewer's yeast was found to be an excellent food for them, though inadequate for larvae of *Aedes serratus*, Theo., or *Psorophora ferox*, Humboldt. Larval development required 26 days at 20°C. [68°F.], 18 days at 25°C. [77°F.] and 12.5 days at 30°C. [86°F.]. Adults developing from larvae kept at lower temperatures were larger and apparently hardier than those from larvae kept at higher temperatures. Data are given on the difference in size. Of the total period of larval development, 26, 14, 17 and 43 per cent., respectively, was spent in the first, second, third and fourth instars, the proportions being the same at the various temperatures tested. Males developed faster than females, the increase in speed of development being demonstrable from the second instar onwards. Attempts to rear larvae at 35°C. [95°F.] failed.

Adults did not survive satisfactorily in cages provided with moisture and kept in a room at 25°C. with a high relative humidity, although mosquitos of the forest floor zone (*A. serratus*, *P. ferox* and *P. cingulata*, F.) thrive under these conditions. *Haemagogus* seemed to require an adequate supply of available moisture, but a relatively dry atmosphere, and best results were obtained with mosquitos in individual screen-stoppered vials [cf. **36** 113] with constant air movement provided by an electric fan. Survival of *A. serratus* and mosquitos

of similar habits was very poor under these conditions. *Haemagogus* adults from larvae kept at 30°C. survived a very short time compared with adults caught in nature. Infection with the virus of yellow fever had no effect on the length of adult life. In general, the lower the temperature at which adults were kept within the range tested (20–35°C.), the longer they survived. Unfavourable effects measurable in decreased oviposition were apparent at 30 and 35°C. Speed of egg development and virus development was almost the same at an alternating temperature of 20 hours daily at 25°C. and four hours at 35°C. as at a constant temperature of 30°C. The proportion of females ovipositing and the average length of life were both greater at the alternating temperature. Differences between behaviour at 25°C. and at the 25–35°C. alternation cannot be accounted for by the increase in mean temperature, since this, calculated on an hourly basis, was only 26.6°C. [79.88°F.].

The relation between the laboratory results and the habits of the mosquito in nature is discussed, together with some comment on the significance of the concept of "optimum temperature".

JENKINS (D. W.). **A Laboratory Method of rearing Chiggers affecting Man (Acarina : Trombiculidae).**—*Ann. ent. Soc. Amer.* **40** no. 1 pp. 56–68, 4 figs., 11 refs. Columbus, Ohio, 1947.

The work described was designed to establish a method of rearing Trombiculids for the provision of colonies for studying the transmission of tsutsugamushi disease (scrub typhus) and to provide larvae for testing acaricides and repellents under controlled conditions throughout the year. It was also desired to obtain information about the pest species of Trombiculids that infest man in the United States, viz., *Eutrombicula alfreddugèsi*, Oudem., and *E. masoni*, Ewing, which are common, and *E. batatas*, L., which is restricted to the south-eastern States. The literature on the rearing of Trombiculids is briefly reviewed. The seven stages in the life-cycle are enumerated [cf. *R.A.E.*, B **37** 61], the protonymph and preadult being also called nymphochrysalis and imago-chrysalis, respectively. Work was begun between December 1945 and March 1946 in Panama, where a complete generation each of *E. batatas* and *Trombicula alleei*, Ewing, was reared by a method similar to Michener's [37 61–62], eggs of *Anopheles albimanus*, Wied., being used as food for nymphs and adults, with moderate success. However, mortality was still about 60 per cent. and production of second-generation eggs unsatisfactory. Therefore, during the following 12 months, when the work was continued in Florida, Texas, Maryland and Ohio with *E. batatas*, *E. alfreddugèsi* and *E. masoni*, new methods and equipment were developed. The first species was reared to the second generation and the other two through four generations.

The colonies were started with larvae collected from naturally infested vertebrate hosts on which they were allowed to complete engorgement and with unfed larvae collected on black boards and transferred to laboratory hosts. The most satisfactory laboratory host was the box turtle, *Terrapene carolina*, although snakes were more attractive. It survived well when fed only between experiments, so that much of the trouble experienced with chicks and mammals through contamination of the collecting equipment with faeces was avoided, and it moulted much less frequently than snakes and lizards and was easier to handle. The larvae did not appear to cause any discomfort or damage to turtles or snakes as they do to birds and mammals. The host was kept in a wire mesh cage over a funnel through which the engorged larvae fell into a rearing jar. Engorgement of larvae on turtles in central Florida took an average of 8 days early and late in the season and 3–4 in July and August. The rearing jar was made by cutting the bottom from a glass screw-top jar with a capacity of 1 U.S. pint and substituting for it a layer of plaster of Paris about  $\frac{3}{8}$  inch thick and

containing about 10 per cent. activated charcoal. This was covered when dry with a thin layer of activated charcoal over which was spread a layer of sterile humus or moist sandy soil  $\frac{1}{4}$  inch deep. A ring of vaseline inside the jar about  $\frac{1}{2}$  inch above the soil prevented larvae from crawling up the glass. The metal lid had a hole in the centre plugged with cotton-wool to provide ventilation and help prevent condensation. Temperature was maintained at about 25–35°C. [77–95°F.] and relative humidity at 86–100 per cent. The soil was moistened daily and the excess moisture allowed to drain through the plaster into a petri dish. The larvae entered the nymphochrysalis stage after about two days, and nymphs emerged in about a week.

Daily moistening of the substratum was continued and the same temperature and humidity were maintained during the rearing of the nymphs and adults. These were fed once a week on eggs of *Aedes aegypti*, L., which were particularly suitable as they remained in good condition for a long time. Young nymphs had difficulty in piercing the shells of mature eggs, and at first only eggs removed from gravid females were used for them, but it was later found that moistening the mature eggs slightly was satisfactory. Excessive wetting caused them to hatch, and the larvae rotted and ruined the culture. Nymphs changed to the imagochrysalis stage in about 10 days, and adults emerged after a further 4–9 days. Adults two days old that had starved for 24 hours ate an average of 15 eggs each in 90 minutes. The optimum number of adults per rearing jar was 30–50. Most eggs were laid at temperature of 27–34°C. [80.6–93.2°F.]. The humidity was kept above 85 per cent. and the substratum quite moist. Eggs were laid singly on the surface or in the interstices of the soil. The average number laid per female per day in September was about ten, and the maximum observed was 20. Individual females oviposited for more than six months. Newly hatched larvae were transferred to a turtle by suspending it over the opened rearing jar, whereupon the larvae crawled rapidly up the jar on to the host.

The minimum length of time required to rear a generation through the complete life-cycle by this method was 50 days for *E. masoni*, 55 for *E. alfreddugèsi* and 71 for *E. batatas*. The times occupied by the various stages are given for each species. The chief disadvantage of the method is the difficulty of obtaining the large quantities of mosquito eggs, for which no substitute has been found.

BRESCIA (F.), WILSON (I. B.), ROWELL (J.) & HODGES (K. C.). **A Study of the Migratory Habits of Salt Marsh and Anopheline Mosquitoes.**—*Ann. ent. Soc. Amer.* 40 no. 1 pp. 69–74, 2 graphs, 1 ref. Columbus, Ohio, 1947.

To facilitate evaluation of the immediate kill of salt-marsh mosquitos and Anophelines effected by DDT released from an aerosol generator [*R.A.E.*, B 36 82–84], the migratory habits of the natural mosquito populations in two test areas (*Aedes taeniorhynchus*, Wied., and *A. sollicitans*, Wlk., in Florida and *Anopheles quadrimaculatus*, Say, in Alabama) were studied. Counts of the numbers of *Aedes* alighting per minute on stationary persons in various situations in and about an open marsh at various times over a period of 24 hours showed that migration from open to shaded areas begins at about dawn and lasts at least an hour. The count in the open marshes was lowest at about 8 a.m., but never fell to zero. It increased slightly in the hot sun of the late afternoon, when biting also occurs in the open. Full migration back to the open marshes starts at about dusk. Greatly increased activity was noticed in the open marshes before dawn and just after dusk. No definite data were obtained on long-range migrations, but it is probable that some of the females leaving the marsh in the early morning go towards towns and do not return until ready to oviposit. It is concluded from the data obtained that a reduction of the alighting rate in open marsh to zero after dispersing a DDT aerosol

at dawn can be attributed to the action of the aerosol, though part of the reduction may be due to migration, that a zero count at 8.30 a.m. in mangroves represents kill and not migration, and that to achieve practical control, open marshes should be treated just before dawn and woods or forested areas after dawn as long as good meteorological conditions can be obtained. Adults of *Anopheles quadrimaculatus* were completely inactive, with no tendency to bite, during periods of sunlight. They left their resting places during the hour following sunset, and were reluctant to bite near their resting places while in flight. They returned to them towards sunrise. They could be controlled by aerosol treatment during the day while they are resting in tree holes, at dusk while they are leaving the holes, and in the early morning while they are returning to them.

BICK (G. H.) & PENN (G. H.). **Resistance of Mosquito Larvae and Pupae to experimental Drought.**—*Ann. ent. Soc. Amer.* **40** no. 1 pp. 82-86, 3 refs. Columbus, Ohio, 1947.

It was observed in New Guinea that temporary pools that dried to the damp-mud stage and were subsequently reflooded often contained numerous Anopheline larvae in late stages of development very shortly afterwards, and preliminary observations showed that fourth-instar larvae of *Anopheles punctulatus*, Dön., could survive for about 120 hours on damp filter paper flooded for 30 minutes at intervals of 24 hours.

Further experiments on the resistance of mosquito larvae and pupae to controlled conditions of drought on damp filter paper were made in the United States with larvae of *Wyeomyia smithi*, Coq., and *Anopheles walkeri*, Theo., and larvae and pupae of *Aedes vexans*, Mg., all collected in New York. These species breed in pitcher plants (*Sarracenia purpurea*), shaded grassy margins of swamps and lakes, and temporary pools, respectively. Observations were made every 24 hours. Under conditions of continuous drought, the maximum times of survival of fourth instars of *A. vexans* and *Anopheles walkeri* were 96 and 120 hours, while some third instars of *A. vexans* and fourth instars of *W. smithi* survived for 120 and 192 hours, respectively, when the experiments on them were terminated. The percentages surviving these exposures were 17, 27, 20 and 83. Results were very erratic with *W. smithi*. Periodic flooding for 30 minutes at intervals of 24 hours was of no apparent benefit in enabling larvae of this species and *Aedes vexans* to survive drought, but considerably prolonged the survival of larvae of *Anopheles walkeri*. A possible reason for this is discussed. Adults emerged from 94 per cent. of pupae of *Aedes vexans* kept under drought conditions. The maximum time of stranding followed by emergence was 72 hours. It is concluded that larvicidal programmes should include treatment of depressions containing damp mud that may subsequently be flooded.

MACKERRAS (I. M.). **Transmission of Dengue Fever by *Aedes* (*Stegomyia*) *scutellaris* Walk. in New Guinea.**—*Trans. R. Soc. trop. Med. Hyg.* **40** no. 3 pp. 295-312, 5 figs., 13 refs. London, 1946.

The experiments that form the subject of this paper were undertaken in an attempt to determine the vector of cases of dengue that occurred, sometimes sporadically but often as epidemics, among troops in parts of New Guinea remote from any known infestation with *Aedes aegypti*, L., the usual vector. The scanty evidence available suggests that the infection was brought to these areas by the troops themselves and found unexpectedly favourable

conditions for propagation. The first experiments, made with *A. funereus* var. *ornatus*, Theo., *A. similis*, Theo., *A. vigilax*, Skuse, and *Mansonia uniformis*, Theo., from Port Moresby were negative and are not described.

Details are given of further work in 1944 in which females of *A. scutellaris*, Wlk., *A. aurimargo*, Edw., *Armigeres breinli*, Tayl., and *A. milnensis*, Lee, collected in the Lae area, where there had been considerable outbreaks, and females of *Aedes scutellaris* bred from larvae collected in the same area were fed on donors with typical infections and then transported by air to New South Wales, where they were allowed to feed on volunteers not previously exposed to the risk of infection. The conditions of transport are described. The only positive results were obtained with *A. scutellaris*. The three men on whom batches of females of this species engorged all developed typical attacks of the disease. The infection was passed serially through two passages by blood inoculation from two of them to other volunteers who had failed to develop the disease after being bitten by the other species of mosquitos, and these two were immune after recovery. The cases are described in detail and the clinical aspects discussed. From the data here recorded and previous published information on the incubation period in man, it is concluded that the incubation period in the mosquito was 13–19 days.

The positive results with *A. scutellaris* adequately explain the occurrence of dengue fever over a wide area in northern New Guinea, where the distribution and abundance of this mosquito agree very closely with the occurrence and prevalence of the disease. They do not explain the cases in the outlying parts of the Moresby district so satisfactorily, as *A. scutellaris* was very rare there at the time and *A. aegypti* did not appear to have extended far into the bush. On the basis of numbers of bites at the relevant period, it is considered that the negative experiments with *M. uniformis*, *A. vigilax*, *A. f. ornatus* and possibly *Armigeres breinli* were satisfactory. Those with *A. milnensis*, *Aedes similis* and *A. aurimargo* were not. The biology and control of *A. scutellaris* are briefly discussed [*cf.* *R.A.E.*, B 36 174–175]. The treatment of tents with DDT to leave a toxic residue is not considered profitable.

FINDLAY (G. M.), HARDWICKE (J.) & PHELPS (A. J.). **Tsetse Fly Repellents.**—*Trans. R. Soc. trop. Med. Hyg.* 40 no. 3 pp. 341–344, 2 refs. London, 1946.

Eight compounds and one mixture of compounds were tested in solution on the human skin as repellents against tsetse flies (almost exclusively *Glossina palpalis*, R.-D.) in the Gold Coast by a method similar to that of Holden & Findlay [*R.A.E.*, B 33 201–202]. Indalone and Formula 622 (6 parts dimethyl phthalate, 2 parts Indalone and 2 parts 2-ethylhexanediol-1,3) [*cf.* 36 88, etc.] reduced the numbers settling from 65 to 22 and from 217 to 74, respectively, and the numbers biting from 52 to 11 and from 162 to 23. N-n-amylsuccinimide, 2-phenyl-cyclohexanol and n-butyl-dlmalate caused a smaller reduction in the numbers settling and biting, while the other four compounds, which included ethylhexanediol but not dimethyl phthalate, had no significant effect. In further experiments in which Indalone and Formula 622 were applied 1–8 hours before exposure, both showed a loss of effectiveness 4–6 hours after application. Exposure to sunlight for 30 minutes somewhat reduced the effectiveness of Formula 622, but heavy sweating did not. Both Formula 622 and Indalone were effective up to 4 hours after application against the bites of West African species of *Culicoides*.

Experiments carried out by L. Berner with the same nine materials against mosquitos showed that one of the most effective was 2-phenylethyl- $\alpha$ -hydroxyisobutyrate, which had no significant action against *G. palpalis*, while n-butyl-dlmalate and 2-phenyl-cyclohexanol were among the least repellent.

BAGSTER-WILSON (D.). **Notes of some Investigations on Mosquito Larvicides.**—*E. Afr. med. J.* **23** no. 8 pp. 239–245, 4 refs. Nairobi, 1946.

Tests of the toxicity of various materials to Anopheline larvae in East Africa are recorded. They showed that dinitro-o-cresol is quite ineffective, and malachite appeared to have no practical value, though it caused complete mortality of *Anopheles funestus*, Giles, in preliminary laboratory experiments. Observations by A. R. Melville indicated that the powdered root of *Derris elliptica*, applied at just over 2 lb. per acre as a 10 per cent. mixture in wood ash or preferably charcoal, was effective and cheap. Benzene hexachloride (666) was tested both in dusts and in oil solution and found to be very effective against all kinds of mosquito larvae, especially in mineral oil. In this form, it gave complete mortality of Anopheline larvae (principally *A. gambiae*, Giles) in the presence of light vegetation in shallow pools when applied at 4 oz. crude material (containing about 10 per cent.  $\gamma$  isomer) per acre. At this dosage, no effect on predators was observed, but all aquatic fauna was killed by 8 oz. per acre.

An account is given of an enquiry into the anti-mosquito oil in use in East Africa. It resulted in the adoption of a mixture consisting of approximately 42 per cent. Inland diesel oil, 31 per cent. dieselene, 18 per cent. furnace oil and 9 per cent. power kerosene, with the addition of 0.6 per cent. fatty acids as a spreading agent. This mixture has given consistently satisfactory results as regards toxicity, spreading pressure (over 20 dynes per cm.) and permanence, and is now the standard product issued as Malariol in East Africa. The experiments had shown that the addition of a spreading agent was required and that bulk testing and mixing at a central point were essential.

GELFAND (H. M.). **Natural Malaria Infection in *Anopheles rufipes* (Gough).**—*J. trop. Med. Hyg.* **50** no. 8 pp. 159–160, 3 refs. London, 1947.

During dissections of Anophelines for malaria parasites at Kano, Northern Nigeria, in 1942, positive results were obtained with *Anopheles funestus*, Giles, *A. gambiae*, Giles, and *A. rufipes*, Gough, sporozoites being found in the salivary glands of one of 19 females of the typical form of the last-named. Previous dissections of small numbers of *A. rufipes* in various parts of Africa had given negative results [cf. *R.A.E.*, B **19** 31], though experimental infection has been obtained in *A. rufipes* var. *ingrami*, Edw. *A. rufipes* was not found in collections of Anophelines made in houses at Kano in August and September. It formed 2.5 per cent. of the total taken from 2nd October to 2nd December, while *A. funestus* and *A. gambiae* comprised 72 and 25 per cent., respectively. It is therefore thought that its local importance as a vector of malaria cannot be great. Its possible importance where it is more abundant cannot be assessed from this work [cf. **36** 134]. Adults were collected in the morning in habitations where *A. funestus* was dominant over *A. gambiae*. At Kano, larvae were found only in large, sunlit, stagnant pools with clean water and upright, grassy vegetation situated fairly close to dwellings. They were frequently associated with *A. funestus*, but never with *A. gambiae*.

KNOWLES (F. L.) & SMITH (C. S.). **Duration of Toxicity of several DDT residual Sprays under Conditions of Malaria-control Operations.**—*Publ. Hlth Rep.* **61** no. 50 pp. 1806–1810, 1 ref. Washington, D.C., 1946.

To determine, in relation to the malaria transmission season, the duration of toxicity to Anophelines of the deposit left by various DDT sprays [cf. *R.A.E.*, B **36** 107] applied under practical conditions, the inside walls and ceilings of 72 houses in Arkansas, where *Anopheles quadrimaculatus*, Say, transmits the

disease from the beginning of June to the end of September, were sprayed on about 1st June 1945 and inspected six times in the following four months. The sprays used were three emulsion concentrates diluted with water to give about 5 per cent. DDT and a preparation containing 3.5 lb. DDT, 10.5 lb. xylene and 0.9 lb. Triton X-100 in 20 U.S. gals. paint. The amount of DDT applied varied from 86.8 to 96.7 mg. per sq. ft. Over the same period, 25 unsprayed houses were inspected as controls. The houses had little or no screening. The sprayed ones harboured very few females of *A. quadrimaculatus* and significantly fewer than the unsprayed ones throughout the 17 weeks of the transmission season, the mean numbers per treated and untreated house at the different inspections being 0.03 and 1.6-7.4, respectively. Little difference was found in the duration of toxicity of the residues from the three aqueous emulsions, but that from the paint preparation was statistically less effective than the others 14 weeks after application.

USINGER (R. L.). **Native Hosts of the Mexican Chicken Bug, *Haematosiphon inodora* (Dugès) (Hemiptera, Cimicidae).**—*Pan-Pacif. Ent.* **23** no. 3 p. 140. San Francisco, Calif., 1947.

*Haematosiphon inodorus*, Dugès, a rather common pest of fowls in the south-western United States and Mexico, has not previously been recorded from a native host. Records are here given of the finding of a series of this species in a nest cave of the California condor (*Gymnogyps californianus*) in California in 1939 and of other collections from the nests of owls in California and Oklahoma in 1939-41. Fowls might easily become infested from these birds of prey, but the occurrence of related genera of Cimicids on swifts and martins suggests that a passerine host may yet be found for *Haematosiphon* from which it may be picked up by birds of prey.

#### PAPERS NOTICED BY TITLE ONLY.

COBBETT (N. G.). **Preliminary Tests in Mexico with DDT, Cubé, Hexachloro-cyclohexane (Benzene Hexachloride), and Combinations thereof** [in sprays], **for the Control of the Cattle Fever Tick, *Boophilus annulatus*.**—*Amer. J. vet. Res.* **8** no. 28 pp. 280-283, 1 fldg. table, 1 ref. Chicago, Ill., 1947. [For brief account see *R.A.E.*, B **37** 89-90.]

WELCH (H.). **Tests of the Toxicity to Sheep and Cattle of certain of the newer Insecticides** [DDT, methoxy-DDT, chlordan and benzene hexachloride].—*J. econ. Ent.* **41** no. 1 pp. 36-39. Menasha, Wis., 1948. [See *R.A.E.*, A **37** 339.]

LÄUGER (P.), PULVER (R.), MONTIGEL (C.), WIESMANN (R.) & WILD (H.). **Mechanism of Intoxication of DDT Insecticides in Insects and warm-blooded Animals.**—24 pp., 6 figs., 5 refs. New York, N.Y., Geigy Co., Inc., 1946. [See *R.A.E.*, A **37** 330.]

FARNSWORTH (M. W.). **The Morphology and Musculature of the Larval Head of *Anopheles quadrimaculatus* Say.**—*Ann. ent. Soc. Amer.* **40** no. 1 pp. 137-151, 17 figs., 16 refs. Columbus, Ohio, 1947.

IMMS (A. D.). **A general Textbook of Entomology.**—7th edn., 10×6 ins., xii+727 pp., 624 figs., many refs. London, Methuen & Co., Ltd., 1948. Price 42s. [With only minor changes from the third edition (*R.A.E.*, B **22** 81).]

KEMPER (H. E.), ROBERTS (I. H.), SMITH (C. E.) & COBBETT (N. G.). **DDT Dips for the Control of Sheep Ticks, *Melophagus ovinus*.**—*J. Amer. vet. med. Ass.* **111** no. 846 pp. 196–199, 3 refs. Chicago, Ill., 1947.

Details are given of the materials and methods used and results obtained in seven tests made on farms and ranches in New Mexico and Colorado in 1945 and 1946 to examine the value of DDT dips against *Melophagus ovinus*, L., on sheep [cf. *R.A.E.*, B **34** 190]. A single immersion in dips containing 0·2 per cent. DDT as a suspension or emulsified solution eradicated infestations, but a single immersion in an emulsified solution containing 0·1–0·15 per cent. or less failed to do so in two out of four tests [cf. **37** 90, etc.]. Examinations of treated animals were made at intervals over a period of at least 90 days. Xylene is suggested as a solvent in preference to benzene, which under certain conditions had a temporarily injurious effect on the sheep. Kerosene and heavy petroleum oils, small amounts of which were used in preparing the emulsions, appeared to cause the sheep little or no discomfort, but no evidence is offered to recommend their use. Suspensions are considered desirable on account of the ease with which they are prepared. However, although the results indicate that DDT will effectively control *M. ovinus*, the authors consider that on the basis of information so far available, suspensions of cubé or derris [**32** 65] are to be preferred to DDT for use against this pest on account of the greater cost and toxicity to mammals of the latter.

RINGUELET (R.). **Zooparásitos de interés veterinario—su distribución en la Argentina según comprobaciones de la Dirección de Patología Animal (1935–1945).** [Animal Parasites of veterinary Interest—their Distribution in Argentina according to Observations made by the Department of Animal Pathology (1935–45).]—*Publ. misc. Minist. Agric. Argent.* no. 281, 54 pp., 20 maps. Buenos Aires, 1948.

The main part of this work consists of a systematic list of parasites (protozoa, worms, insects, ticks and mites) that attack domestic animals and birds in Argentina, showing their hosts and locality records and the diseases if any that they cause. It also contains a list of the parasites arranged under the hosts attacked, showing the first authors to record them in Argentina, so far as known, and a short list of parasites of man and a few non-domestic animals and birds.

KETTLE (D. S.) & SELICK (G.). **The Duration of the Egg Stage in the Races of *Anopheles maculipennis* Meigen (Diptera, Culicidae).**—*J. Anim. Ecol.* **16** no. 1 pp. 38–43, 2 figs., 12 refs. London, 1947.

Females of three races of *Anopheles maculipennis*, Mg., caught in nature in Italy in the spring of 1945 oviposited on water in small cages, and the incubation periods of the eggs were observed in relation to mean shade temperatures from late February to June. The findings were examined statistically. Eggs of race *typicus* developed more rapidly than those of races *labbranchiae*, Flñi., and *melanoon*, Hackett. The difference was pronounced at 10°C. [50°F.] but decreased with rising temperature until it became negligible at 20°C. [68°F.]. The shorter development period of the eggs of *typicus* is probably an adaptation to the more rigorous climate to which this race is exposed; it is widely distributed throughout northern and central Europe, whereas *labbranchiae* is Mediterranean and *melanoon* has been recorded only from northern and central Italy [but cf. *R.A.E.*, B **29** 29; **34** 123, etc.].

TRAVIS (B. V.). **Three Species of Flies predaceous on Mosquito Larvae.**—*Proc. ent. Soc. Wash.* **49** no. 1 pp. 20–21. Washington, D.C., 1947.

The Ephydrid, *Ochthera canescens*, Cress., and the Dolichopodid, *Paraclius germanus*, Parent, were observed catching and feeding on larvae of *Culex annulirostris*, Skuse, *C. fatigans*, Wied. (*quinquefasciatus*, auct.) and Chironomids on Guam and the Ephydrid, *O. brevititilis*, Meij., was seen to feed on Anopheline and Chironomid larvae on Guadalcanal in the Solomon Islands. These flies were sufficiently numerous around isolated pools to cause a local reduction in the mosquito population, but were not abundant over a sufficiently large area to reduce the population generally. The ways in which they capture their prey are briefly described.

STONE (A.). **A topotypic Male of *Aedes scutellaris* (Walker) (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **49** no. 3 p. 85. Washington, D.C., 1947.

The author has examined the male genitalia of a specimen of *Aedes* from the Aru Islands, the type locality of *A. scutellaris*, Wlk., and has found them to be identical with genitalia from specimens of the only species of *Aedes* of the *scutellaris* group known to occur in New Guinea and from specimens from the New Hebrides, all of which agree with *A. hebrideus*, Edw. New Guinea is the type locality of *A. zonatipes*, Wlk. The author therefore considers both *A. hebrideus* and *A. zonatipes* to be synonyms of *A. scutellaris* [cf. *R.A.E.*, B **34** 37; **36** 174].

PRATT (H. D.). ***Shannonomyina*, new Name for *Shannonomyia* Dyar (not Alexander) (Diptera, Psychodidae).**—*Proc. ent. Soc. Wash.* **49** no. 3 p. 86. Washington, D.C., 1947.

A new name *Shannonomyina* is proposed for *Shannonomyia*, Dyar, erected as a subgenus of *Phlebotomus* in 1929 [*R.A.E.*, B **17** 208], as it is preoccupied by the Tipulid genus *Shannonomyia* erected by Alexander earlier in the same year.

PIJOAN (M.). **New Insect Repellents.**—*Soap & sanit. Chem.* **23** no. 3 pp. 124–127, 173, 175, 1 fig., 11 refs. New York, N.Y., 1947.

An account, including the tabulated results of tests against mosquitos, is given of the work on insect repellents that led to the development of the mixture of 2-phenyl-cyclohexanol and 2-cyclohexyl-cyclohexanol designated NMRI 448 [*R.A.E.*, B **37** 130], which was the most satisfactory of a large number tested. It is stated that for critical evaluation of repellents, tests must be carried out under constant environmental conditions, preferably those simulating hot tropics where repellents are most needed, test subjects must remain within the test environment at all times (since changes in environment tend to prolong effectiveness), and the repellents must be tested for toxicity to man. Protection periods under simulated tropical conditions (90°F. dry bulb, 80°F. wet bulb) were shorter than under more moderate conditions (80° dry bulb, 70° wet bulb). Most of the decrease was brought about by dry heat (90° dry bulb, 70° wet bulb). Increasing humidity (90° dry bulb, 80° wet bulb) produced only a slight additional decrease in repellence.

MADDEN (A. H.), LINDQUIST (A. W.) & JONES (H. A.). **Fly Larvicide Tests.**—*Soap & sanit. Chem.* **23** no. 3 pp. 141, 143, 2 refs. New York, N.Y., 1947.

The following is based on the authors' summary. Tests in which larvae of *Musca domestica*, L., were immersed for five seconds in the solutions or solvents showed that DDT (5 per cent.) in more than thirty solvents did not add materially to the mortality caused by the solvent alone. The solvents producing the highest kill with DDT were equally or more effective without it. Poor results were obtained with DDT in emulsified solutions. Among 25 other materials tested, including several surface-active agents and common acid and alkalis, benzene hexachloride and 2,4-dinitro-6-cyclohexylphenol were the most toxic, the former giving complete kill at 5 per cent. in benzene with the addition of 5 per cent. Triton X-100 or at 10 per cent. in benzene alone, and the latter at 5 per cent. in benzene or no. 2 fuel oil. The toxicity of hydrochloric acid, potassium hydroxide, ammonium hydroxide and mercuric chloride was almost negligible, indicating that the body covering of the larvae gave a high degree of protection against them.

BARBER (G. W.). **The Lethal Lines of the House Fly.**—*J. econ. Ent.* **41** no. 2 pp. 292–295, 4 figs. Menasha, Wis., 1948.

In the course of work on the rearing of *Musca domestica*, L., two remarkable strains, designated the lethal line and the flat line, were isolated and maintained in pure cultures. The puparia of these lines are much different from those of normal lines and are described and figured. It is not known whether there are differences also in the larvae or adults. The puparia of the lethal line are much more elongated than normal ones and have an open pore anteriorly, probably because the larvae are unable to retract their mouth-parts normally when forming the puparia. Both these abnormalities are the cause of mortality, since many flies are unable to emerge from the elongated puparia, and some of the pupae are destroyed by larvae of their own species that enter the puparia through the open pore. In nature, they would be similarly exposed to attack by predators and micro-organisms, and the latter may have caused some of the mortality observed in the cultures. The lethal line was produced by selective breeding begun in July 1946, and was pure in the  $F_4$  generation. It was in the  $F_{27}$  generation on 20th November 1947. Puparia of the lethal type have been found in nature in New Jersey, and were present in occasional culture jars of normal lines at rates of less than 1 per cent. of the population. Of the flies from whose progeny the line was produced, 2.5 per cent. had emerged from puparia of the lethal type, and all were the offspring of one female. In crossing experiments in which males or females of the lethal line were mated with the opposite sex of three normal lines, there was usually little if any increase in the incidence of lethal puparia in the  $F_1$  generation over those found in the normal lines, but in the  $F_2$  generation about a quarter of the puparia were of the lethal type. Thereafter, the proportion of the lethal type decreased regularly until the tenth generation, when the tests were discontinued. Proportions of males and females were equal in lethal and normal lines, the two lines were similar in variation in weight with density of population, and puparia of the lethal type were similar whatever suitable medium they were reared in.

The flat line was established in November 1946, from a culture originating from puparia collected out-of-doors. Puparia of this line are somewhat flattened and rather rectangular and have very distinct segments. Characteristically, they do not have open pores, but individuals of the lethal type are more plentiful among them than in normal lines. By 20th November 1947, the flat line was in the  $F_{16}$  generation. Normal puparia had occurred in the selected cultures until the  $F_{12}$  generation. Emergence in the flat line was less than in

the normal lines but much higher than in the lethal line. These lines are being investigated to determine whether lethal lines of insects can be used in the biological control of injurious species.

SACKTOR (B.), HUTCHINSON (M.) & GRANETT (P.). **Biology of the Lone Star Tick in the Laboratory.**—*J. econ. Ent.* **41** no. 2 pp. 296–301, 2 figs., 4 refs. Menasha, Wis., 1948.

To provide a supply of ticks for testing acaricides and repellents, *Amblyomma americanum*, L., was reared in quantity in the laboratory at Rutgers University, rabbits being used as hosts. Two small ventilated boxes with a hole 1.25 ins. in diameter in the bottom were fixed to the shaven skin of the host, one on each side, with chamois leather coated with adhesive and having a slightly smaller hole. They were covered by a sheet rubber guard wrapped round the rabbit to prevent it from dislodging them. As many as eight adults (four of each sex), 50 nymphs or 500 larvae could be accommodated in one box 1.75 ins. in diameter. They were introduced through a hole in the lid. It was necessary to bring unengorged larvae into direct contact with the skin of the animal. The optimum conditions for the moulting of engorged larvae and nymphs appeared to be a temperature of 30°C. [86°F.] and a relative humidity of 85–100 per cent. A special holding tube designed to meet the high humidity requirements is described. When all non-parasitic periods were passed at 30°C., the average time required to complete a generation was 81 days, including 25 days for the egg stage, 4–5, 5 and 13 days for engorgement of larvae, nymphs and adult females, 10 and 16 days between engorgement and moulting of larvae and nymphs, and 7 days between engorgement of females and the beginning of oviposition. In laboratory practice, two weeks are allowed between ecdysis and replacement on the host. Thus, the complete life-cycle can be obtained in about four months. In the work described, 73 per cent. of the larvae and 80 per cent. of the nymphs placed on hosts engorged successfully. The number of eggs laid by one female varied in the batches counted from 260 to 9,000, with a mean of 3,420.

MENUSAN jr. (H.). **Comparative Toxicity of Insecticides administered in various Ways to several Species of Insects.**—*J. econ. Ent.* **41** no. 2 pp. 302–313, 15 refs. Menasha, Wis., 1948.

The following is based on the author's summary. The insecticidal activity of various materials was tested against *Periplaneta americana*, L., by blood stream injection, by contact and by oral feeding. The dosage of insecticide needed to be toxic by contact was usually about twice that by injection. Pyrethrum was the only material that was equally toxic by contact and by injection. There was a striking similarity in the reaction of the cockroach to contact and stomach poisons. Materials not toxic by contact were not toxic when administered orally, and those that were toxic by contact were toxic as stomach poisons also. The minimum dosage that was toxic by feeding was usually considerably higher than the minimum dosage of the same material that was toxic by contact. Differences in resistance between the sexes varied with the insecticide used and the method of testing. The female was always more resistant than the male except to dichlorethyl ether. Differences between the sexes were smallest in the tests by injection into the blood stream. In these, the resistance of the female averaged 1.6 times that of the male. In contact and feeding tests, the resistance of the female averaged 3–4 times that of the male. The administration of predetermined dosages to individual insects increased the accuracy of the evaluation of insecticidal effectiveness. On account of the differences in resistance, it is important either to test the sexes separately

or to be sure that they are represented in equal numbers. Tests of toxicity by injection and by contact were also made against other insects, which varied greatly in susceptibility [*R.A.E.*, A 37 395].

PIQUETT (P. G.). **Benzene Hexachloride and Cornstarch as a Roach-control Combination.**—*J. econ. Ent.* 41 no. 2 pp. 326–327, 3 refs. Menasha, Wis., 1948.

In tests in which adult females of *Periplaneta americana*, L., were fed for ten days on tablets made of dog food with the addition of 2 per cent.  $\gamma$  BHC (benzene hexachloride), maize starch or both, the tablets containing both gave complete kill while those containing BHC alone gave 27 per cent. kill and those containing starch alone 3 per cent. In all cases, the dog food masked the odour of the BHC. Tested further against *P. americana*, *Blattella germanica*, L., *Blatta orientalis*, L., and *Supella supellectilium*, Serv., the tablets containing starch and BHC caused complete mortality in four days in all cases. Tests on the amounts of the various ingredients alone and in combination consumed by females of *P. americana* in two hours showed that where BHC and dog food were present, the amount consumed was not increased by the presence of the starch so that the increased kill when it was present must be attributed to synergistic action and not to enhanced attractiveness. When 2 per cent. starch and  $\gamma$  BHC were tested in fuller's earth by the crystallising-dish technique [*R.A.E.*, B 37 102–103] instead of in dog food, the average mortality after ten days among females of *P. americana* was 12 per cent. with BHC, 3 per cent. with starch and 55 per cent. with both ingredients.

HEAL (R. E.). **Rearing Methods for German and American Cockroaches.**—*J. econ. Ent.* 41 no. 2 pp. 329–330. Menasha, Wis., 1948.

Routine methods by which cultures of *Blattella germanica*, L., and *Periplaneta americana*, L., have been maintained at Rutgers University since 1940 are described. Both species are kept at 73–77°F. with a relative humidity of 50–70 per cent., and the nymphs are reared in battery jars, 8 ins. deep and 6 ins. in diameter, containing platforms standing, one on another, on legs  $\frac{1}{4}$  in. long.

About 100 reproducing females of *B. germanica* are kept in a wire-gauze cage on the upper of two platforms in a battery jar, on to which the newly hatched nymphs escape. Five cages in continuous operation yield about 2,000 nymphs weekly. A water supply with a device to prevent drowning is provided in the cage and on the upper platform outside it. Pellets of dog food are provided in the gauze cage, and sugar and pulverised dog food on one of the platforms. Once a week, the supply of gravid females in the cage is replenished and the nymphs are transferred to battery jars containing ten platforms. Water and pellets of dog food are provided. The ten platforms give enough floor space for rearing 400 cockroaches to maturity, but stocks are transferred to clean cages after five weeks to prevent the establishment of a mite infestation. Under these conditions, most individuals reach the adult stage in nine weeks.

In the case of *P. americana*, egg capsules are separated from the refuse taken from the cages containing adults at each monthly cleaning and placed in a glass jar in a layer not more than  $\frac{1}{4}$  in. thick. Once a week, the freshly hatched nymphs, for which water and sugar have been provided for four days, are transferred to battery-jar cages. These are similar to those used for *B. germanica* except that the bottom is covered with cotton gauze or filter paper, which enables young nymphs to regain their feet if they fall on their backs. Pellets of dog food and water are supplied, and also sugar when a new colony is established. In one of these cages, 400 cockroaches can be reared

to the age of three months. At this age, they are transferred to gauze-covered cages 12 ins. long, 8 ins. wide and 6 ins. high, having a wooden floor and framework and a sliding glass front. Each cage contains seven platforms  $\frac{1}{2}$  in. apart. Water and dog food are provided and the floors of the cages are cleaned once a month. Each cage will accommodate 150 cockroaches until they reach maturity, which is generally at the age of seven months.

GERSDORFF (W. A.) & NELSON (R. H.). **Toxicity to House Flies of three Phosphorus Acid Esters.**—*J. econ. Ent.* **41** no. 2 pp. 333–334, 5 refs. Menasha, Wis., 1948.

The effectiveness of hexaethyl tetraphosphate [*R.A.E.*, A **37** 214], tetraethyl pyrophosphate [A **37** 235] and O,O-diethyl O-*p*-nitrophenyl thiophosphate (parathion) when applied as space sprays against *Musca domestica*, L., was investigated in Maryland. All materials used were of the technical grade. A 1:1 mixture of acetone and refined kerosene was used as the solvent throughout. As both hexaethyl tetraphosphate and tetraethyl pyrophosphate are unstable in the presence of water, the acetone was dried before use and the sprays were prepared just before they were tested. The mean mortalities caused in one day by various concentrations of the three esters are shown in a table. On the basis of concentrations required for 50 per cent. mortality, tetraethyl pyrophosphate was 5.5 times and parathion 17 times as toxic as hexaethyl tetraphosphate, which was itself about twice as toxic as the standard pyrethrum extract.

LOGOTHETIS (C.) & SCHWARDT (H. H.). **Biological Studies on the Horse Flies of New York.**—*J. econ. Ent.* **41** no. 2 pp. 335–336. Menasha, Wis., 1948.

Tabanids are probably the most injurious blood-sucking pests of cattle in New York. The most important species attacking dairy cows are *Tabanus costalis*, Wied. (*vicarius*, Wlk.), *T. lasiophthalmus*, Macq., and, to a smaller extent, *Chrysops vittata*, Wied. Adults of *T. lasiophthalmus* begin to emerge in May and are present until early July, *T. costalis* appears in June and is numerous until the latter part of August, and *C. vittata* is in the field from June to September and most abundant in July.

As immature stages of the two species of *Tabanus* have never been found in habitats of the aquatic or semi-aquatic type in which most Tabanids breed, it was thought that they must develop in pastures and meadows, and investigations in which sections of sod were suspended in wire racks over pans of water, so that when the sod dried any larvae present dropped into the pans, showed one larva of *T. costalis* per sq. ft. in sod from many areas. Since laboratory rearing has shown a sex ratio of 1:1 in this species, this indicates that 10,000 females can be produced on an acre of pasture. Night sweepings in meadows during the season of emergence of *T. costalis* yielded 5–15 adults per 100 strokes of the net. The sex ratio agreed with that obtained in the laboratory and many individuals were teneral. Larvae of several sizes were numerous during the emergence season in 1947 in a plot 400 sq. ft. in area in which several thousand eggs had been placed in the previous year, and a number of flies emerged. The plot was surrounded by a sheet iron barrier extending one foot above ground and about 18 ins. below and was covered with cloth during the emergence season. During the year, the extreme conditions normal to the area were experienced, including partial drought in late summer and total submergence for several days in spring. It was anticipated that more flies would emerge in 1948, since laboratory rearing had shown that over 90 per cent. of the individuals have a two-year cycle. The authors were unable to make any quantitative collections of the immature stages of *T. lasiophthalmus*

with the methods used in taking larvae of *T. costalis*. One egg mass was obtained from a caged female, and 40 of the larvae from it were fed in individual cages. Eight of them produced adults after 10–11 months. The pupal period lasted 11–15 days.

*C. vittata* was reared from egg to adult by keeping the larvae in mud from the natural habitat and feeding them on larvae of several small species of Tipulids or on blowfly maggots. The mud was heated sufficiently to kill all Arthropods, then placed in large shallow pans and remoistened. The pans were slightly raised at one end to provide a gradient of moisture up to complete submergence. The eggs hatched from 7th to 10th July 1946, and adults emerged between 30th June and 18th August 1947.

BRUCE (W. G.), SMITH (A. L.) & SKIPPER (C. C.). **Screwworm Survey of the southeastern States in 1945.**—*Florida Ent.* **29** no. 1 pp. 1–4, 1 fig., 2 refs. Gainesville, Fla., 1946.

The following is substantially the authors' summary. Surveys of *Callitroga hominivorax*, Coq. (*Cochliomyia americana*, Cush. & Patt.) on livestock in the south-eastern United States in 1945 [cf. *R.A.E.*, B **34** 164, etc.] showed infestations to be widespread in Florida, Georgia and Alabama, and light to heavy in South Carolina. They reached outbreak proportions in Alabama and south-western Georgia. Climatic conditions throughout the spring and summer were favourable for the development and migration of *C. hominivorax*. The practice of approved control measures prevented a more serious outbreak.

MADDEN (A. H.), LINDQUIST (A. W.), LONGCOY (O. M.) & KNIPLING (E. F.). **Control of adult Sand Flies by Airplane Spraying with DDT.**—*Florida Ent.* **29** no. 1 pp. 5–10, 2 refs. Gainesville, Fla., 1946.

The following is substantially the authors' summary. Tests were carried out in Florida in 1945 to determine the effectiveness of spraying with DDT from an aeroplane against adults of *Culicoides*. In the treatment of a black-mangrove swamp 200 acres in extent with a 5 per cent. solution of DDT at 2 U.S. quarts per acre, a high degree of control was maintained over a period of four days, and some additional control up to two weeks after treatment was indicated. Comparable results were obtained when a similar solution was applied at the same rate over 200 acres of salt marsh and at 1 U.S. gal. per acre over an air station. The treated area of marsh was 2,000 ft. wide and served as a barrier against *Culicoides* moving towards the station. Observations on the station grounds showed that this area was completely protected for five days. It is concluded that the method shows promise.

DE MEILLON (B.). **New Records and Species of biting Insects from the Ethiopian Region. II.**—*J. ent. Soc. sthn Afr.* **10** no. 1 pp. 110–124, 4 figs. Pretoria, 1947.

In this second paper of a series [cf. *R.A.E.*, B **33** 153], descriptions are given of both sexes of *Anopheles mascarensis*, sp. n., reared from larvae taken in Madagascar, two new Ceratopogonids from the Transvaal, and five new fleas, including four of the genus *Xenopsylla*, from various parts of Africa. A list is also given of 33 species of mosquitos recorded from Bechuanaland. Of these, 11 belong to the genus *Anopheles*, one being represented by two varieties.

MUSPRATT (J.). **The Laboratory Culture of a Nematode Parasite of Mosquito Larvae.**—*J. ent. Soc. sthn Afr.* **10** no. 1 pp. 131–132, 4 refs. Pretoria, 1947.

Nematode worms of the *Agamomermis* group have been found in the body cavity of mosquito larvae at Livingstone, Northern Rhodesia, and other parts

of Africa [cf. *R.A.E.*, B 37 32-33]. It seems probable that those in tree-hole larvae belong to the same species as those in larvae in swamps and streams, and that the rearing method described below could also be used for the latter. In 1945, about 100 nematode larvae that had recently emerged from naturally parasitised mosquito larvae from tree holes at Livingstone were placed in a jar ( $7 \times 3\frac{1}{2}$  ins.) containing  $4\frac{1}{2}$  ins. sandy soil and filled up with water. A few days later, when the larvae had become dormant in the sand, the water was decanted. The sand was allowed to become almost dry by leaving the jar partly uncovered for several months, and the lid was then replaced to prevent complete desiccation. Some 11 or 12 months after the collection of the larvae, part of the soil was transferred to a smaller jar, and water and over 100 newly hatched laboratory-bred larvae of *Aedes aegypti*, L., were added. Within 24 hours, some of the *Aedes* larvae contained small nematodes in the haemocoel, and infective nematodes could also be detected with a hand lens in water taken from the surface. Some of the *Aedes* larvae were examined microscopically every 24 hours by placing them one by one on a hollowed slide and removing most of the water with a pipette. When 70-80 per cent. of them appeared to be parasitised, they were transferred with the water to a larger rearing vessel, and the infection jar was refilled with water and more newly hatched *Aedes* larvae added. The nematode eggs continued to hatch for 2-3 weeks. The parasitised larvae in the rearing vessel were given more water and abundant food. The nematode larvae, which emerged after 10-14 days, were removed to a jar containing sandy soil and water, so that they could develop as had the previous generation. The indications are that the adults die after laying eggs in the nearly dry sandy soil, and that the life-cycle lasts 11-12 months in nature. Adults have developed and eggs been laid in quite small tubes of sand.

PIELOU (D. P.). **Anopheline Mosquitoes breeding in Fish Dams, Pools and Streams in Northern Rhodesia.**—*Proc. R. ent. Soc. Lond.* (A) 22 pt. 1-3 pp. 18-23, 3 refs. London, 1947.

Details are given of the results of an investigation made between March 1944 and May 1946 into the species of *Anopheles* breeding in about  $\frac{1}{2}$  sq. mile of water in dams, pools, streams and other works used in experimental fish farming at Chilanga, Northern Rhodesia, as part of measures to develop the territory's inland fisheries. It was desired to establish whether such measures would cause an increase in the population of malaria vectors. Of the 2,304 Anophelines bred from the larvae collected and subsequently identified, which belonged to 12 species, 71 were *A. gambiae*, Giles, 36 *A. funestus*, Giles, and 1,321 *A. rufipes*, Gough. It is concluded that a fish-farming establishment in general does not increase the risk of malaria. Small pools should be drained when not in use as they are then suitable for *A. gambiae*, but when the young fish are present, they destroy the larvae, which are probably rendered particularly vulnerable through their marked preference for sunlit water. The larger pools and dams, if exposed, are unlikely to favour the increase of either *A. gambiae* or *A. funestus*. Seepage water from under dam walls and associated puddles provide breeding places for *A. funestus* and *A. gambiae*, respectively. The remedy for this is sound dam construction. Water supply furrows or ditches may harbour *A. funestus*, and they should be allowed to dry out periodically.

PARR (H. C. M.) & BUSVINE (J. R.). **A Spinning-disk Sprayer for applying residual Insecticides.**—*Ann. appl. Biol.* 35 no. 3 pp. 359-368, 5 figs., 2 refs. London, 1948.

The following is almost entirely the authors' summary. In view of the need in laboratory tests of persistent synthetic insecticides for convenient and reliable

equipment for applying standard deposits to various surfaces, an apparatus employing the spinning-disk principle [*cf.* *R.A.E.*, A **37** 20] was used. It consists essentially of a spinning disk that throws off liquid, applied to its centre, in the form of small droplets. These are of the same order of size (about 0.1–0.4 mm. in diameter) as those produced by knapsack sprayers, which are most satisfactory for applying persistent insecticides to walls and similar surfaces, but they are more uniform and consistent. The sprayer can be used to coat various surfaces, up to 1 ft. square, with deposits of insecticides in oil solution or in aqueous emulsions or suspensions. The deposits can be controlled and estimated with a fair degree of precision.

MILNE (A.). **Pasture Improvement and the Control of Sheep Tick (*Ixodes ricinus* L.).**—*Ann. appl. Biol.* **35** no. 3 pp. 369–378, 22 refs. London, 1948.

In Britain, *Ixodes ricinus*, L., is practically confined to rough, poor hill and moorland pastures [*R.A.E.*, B **32** 232], where it is a major pest of sheep. Pastures of the bent grass and bracken type are characterised by a rank, dense surface vegetation with an underlying layer of mat or litter and moss [**27** 93] that has a very high humidity, making possible the survival of the ticks, which are very susceptible to desiccation [*cf.* **36** 211]. Agricultural improvement of these pastures involves, among other things, reducing the depth of the vegetation layer and partly or completely destroying the moisture-holding mat of decaying vegetable matter. Assessment of the tick populations on improved and on comparable control areas showed a reduction in tick population following pasture improvement, but a fairly considerable degree of improvement was required to bring about a satisfactory reduction. Ticks were not completely extirpated even by ploughing, and only drastic methods (disking, harrowing or ploughing) had any marked effect. They appeared to cause reductions of 50–95 per cent. Pasture improvement is not economic on hill and moorland grazings in general. Such improvement as is practicable there could only be a supplement to other control measures. Since the sheep support almost all the female ticks on a pasture, control is most likely to follow from the development of an efficient dip that would remain effective over the period of 5–6 weeks that must elapse between dippings during the lambing season.

SIMIĆ (Č.) & ŽIVKOVIĆ (V.). **Sur une nouvelle espèce de flébotome dans la Serbie méridionale.**—*Acta med. iugoslav.* **1** fasc. 3 pp. 193–203, 6 figs. Belgrade, 1947. (With a Summary in Russian.)

The first cases of kala-azar (visceral leishmaniasis) diagnosed in southern Serbia occurred at the end of 1945 among young children from the neighbourhood of Prokuplje, and during the next two years more than 350 cases were seen in unconnected areas mostly in the districts of Prokuplje, Leskovac, Nish and Aleksinac. When the disease was first discovered, the only species of *Phlebotomus* known to occur in the region was *P. papatasi*, Scop., which had increased greatly in abundance since the war and was responsible for an epidemic of sandfly fever but does not transmit kala-azar. Collections made over a period of two months (July and August) in 47 villages in which cases of kala-azar had occurred revealed the presence of very large numbers of sandflies belonging to six species. These were *P. papatasi*, *P. chinensis* var. *simici*, Nitzu., *P. major*, Annan., *P. tobbi*, Adl. & Thdr., *P. caucasicus*, Marz., and a previously undescribed species. Detailed descriptions are given of both sexes of this last, but no name is proposed for it. It is semi-domestic, being found both in bedrooms and in animal sheds, latrines, cellars, derelict houses and burial vaults, and comes readily to light during the early hours of the night. The northern limits of its distribution are not known. To the south, it became

scarcer as distance from the epidemic area increased. In view of its abundance in the epidemic area and the fact that it and *P. papatasi* were the only species taken in one village where several cases of kala-azar occurred, it is considered to be the most important local vector.

WEYER (F.). **Grundriss der medizinischen Entomologie, mit Einschluss der übrigen medizinisch wichtigen Gliederfüßler.** [An Outline of medical Entomology, including other Arthropods of medical Importance.]—2nd revd. edn.,  $9\frac{1}{4} \times 6\frac{1}{4}$  ins., viii+132 pp., 63 figs., 26 refs. Leipzig, J. A. Barth, 1948, Price DM.10.

This short handbook was compiled to supplement the educational leaflets that are being published in Germany at irregular intervals. It contains five chapters, and the subjects dealt with are: the structure and development of Arthropods; the ways in which they attack man or domestic animals, cause discomfort or transmit disease; the morphology, habits and medical importance of the various groups concerned, with examples drawn from many parts of the world; their control, including the treatment of stings and bites; and methods of capturing and breeding Arthropods and dissecting and preserving specimens.

[**A Series of Papers on Q Fever.**]—*Amer. J. Hyg.* 44 no. 1 pp. 1-182. Lancaster, Pa., 1946.

This series of 12 papers comprises **Q Fever : a Foreword. Introduction to a Series of Papers dealing with Q Fever** (pp. 1-5, 29 refs.) by the authors of the following papers; **Q Fever in the Mediterranean Area : Report of its Occurrence in Allied Troops. I. Clinical Features of the Disease** (pp. 6-22, 6 figs., 22 refs.) by F. C. ROBBINS & C. A. RAGAN, **II. Epidemiology** (pp. 23-50, 8 figs., 33 refs.) by ROBBINS, R. L. GAULD & F. B. WARNER, **III. The Etiological Agent** (pp. 51-63, 1 fig., 20 refs.) by ROBBINS, R. RUSTIGIAN, M. J. SNYDER & J. E. SMADEL, and **IV. A Laboratory Outbreak** (pp. 64-71, 1 fig., 9 refs.) by ROBBINS & RUSTIGIAN; **Epidemics of Q Fever among Troops returning from Italy in the Spring of 1945. I. Clinical Aspects of the Epidemic at Camp Patrick Henry, Virginia** (pp. 72-87, 9 figs., 20 refs.) by M. FEINSTEIN, R. YESNER & J. L. MARKS, and **II. Epidemiological Studies** (pp. 88-102, 3 figs., 10 refs.), and **III. Etiological Studies** (pp. 103-109, 12 refs.) by The Commission on Acute Respiratory Diseases, Fort Bragg, North Carolina, of which the Director is J. H. DINGLE; **Identification and Characteristics of the Balkan Grippe Strain of *Rickettsia burneti*** (pp. 110-122, 2 figs., 28 refs.) and **A Laboratory Outbreak of Q Fever caused by the Balkan Grippe Strain of *Rickettsia burneti*** (pp. 123-157, 20 figs., 21 refs.) also by the Commission; **The Identification of Q Fever in Panama** (pp. 158-172, 6 figs., 11 refs.) by G. CHENEY & W. A. GEIB; and **Q Fever : an immunological Comparison of Strains** (pp. 173-182, 1 fig., 8 refs.) by N. H. TOPPING, C. C. SHEPARD & R. J. HUEBNER.

It is concerned with studies on a febrile disease resembling primary atypical pneumonia that occurred endemically and epidemically in the Mediterranean area and was also observed in Panama during the latter part of the second world war. Eight outbreaks are known to have occurred among allied troops in Italy, Greece and Corsica during the winter and spring of 1944-45. A form occurring in Greece was referred to by the Germans as Balkan grippe. The etiological agent of the disease was shown in work reported in the fourth, ninth and eleventh papers to be a strain of *Rickettsia burneti* (*diaporica*), the causal agent of Q fever, hitherto known only from Australia [R.A.E., B 28 226-229] and the United States [28 229-230]. In the last paper, complete cross immunity in guineapigs is shown to exist between the Australian, United States, Italian, Balkan grippe and Panama strains. Complement-fixation

and agglutinin absorption tests indicated similarity in immunological specificity, although there were great variations in the sensitivity of the antigens.

The mode of spread was not determined. It is reported in the third paper that the mites, *Tyrophagus* (*Tyroglyphus*) *longior*, Gerv., *Tyroglyphus farinae*, Deg., *Glyciphagus domesticus*, Deg., *Eulaelaps* (*Laelaps*) *stabularis*, Koch, and *Cheyletus venustissimus*, Koch, were found in chaff in a barn-loft around which one Italian outbreak centred, and adults and larvae of *Argas reflexus*, F., and a number of *Xenopsylla cheopis*, Roths., were found in pigeons' nests in the walls, but exceedingly few bites were reported. Most of the epidemics were associated with the presence of animals (pigeons, rats, mice, cattle, etc.), some of which may act as reservoirs of infection. There was often a correlation between outbreaks of the disease and the use of hay mattresses, and there was a striking association with dust. Such dust, whether or not in association with hay and straw, could be infected by contamination with the excreta of vertebrates or of their parasites, and it is possible that transmission may be effected by inhalation of contaminated dust [cf. 31 106] or of dust containing mites [cf. 36 200, etc.] if these should prove to harbour the infection.

In the laboratory outbreaks described in the fifth and tenth papers, it appeared that association with infected chick embryos was more dangerous than association with infected guineapigs, and transmission by inhalation of infected droplets or dust or particulate matter in the air is postulated.

RIVERS (T. M.). Ed. **Viral and Rickettsial Infections of Man.**— $10\frac{1}{4} \times 7$  ins., xvi+[1+]<sup>587</sup> pp., frontis., 6 col. pls. (1 fldg.), 46 figs., 31 charts, many refs. Philadelphia, Pa., J. B. Lippincott Co., 1948. Price 45s.

This work comprises a general introduction by the editor and chapters on physical and chemical procedures, serological reactions in virus and rickettsial infections, chick-embryo techniques, propagation of viruses and rickettsiae in tissue cultures, epidemiology, and viruses that attack bacteria and also chapters on individual virus or rickettsial diseases or groups of diseases, each written by a contributor of authority, nearly 30 workers having co-operated in the production of the book. The chapters on the various diseases have sections on history, clinical aspects, pathology, experimental infection and host range, etiology, diagnosis, treatment, epidemiology and control. Those on diseases with the transmission of which Arthropods are or may be concerned are Viral Encephalitides (pp. 163–212) by P. K. Olitsky & J. Casals; Poliomyelitis (pp. 245–268) by H. A. Howe; Colorado Tick Fever (pp. 416–419) by H. R. Cox; Yellow Fever (pp. 420–440) and Rift Valley Fever (pp. 441–444) by M. Theiler; Dengue (pp. 445–453) and Phlebotomus Fever (pp. 454–461) by A. B. Sabin; The Typhus Fevers (pp. 462–492) by J. C. Snyder; The Spotted-fever Group (pp. 493–515) by Cox; and Scrub Typhus (pp. 516–528) and Q Fever (pp. 529–538) by J. E. Smadel. Brief reference to trench fever is made in a chapter on infections of minor importance by Rivers. There is a bibliography at the end of each chapter.

POLLARD (M.), DAVIS (D. E.) & OLSON (T. A.). **The serological Detection of Murine Typhus in Flea Feces.**—*Amer. J. Hyg.* 44 no. 2 pp. 244–248, 1 fig., 4 refs. Lancaster, Pa., 1946.

A description is given of a method of detecting the agent of murine typhus fever in the faeces of fleas by using the faeces as complement-fixing antigen with known positive and known negative typhus antiserum. The presence of infective fleas can be rapidly determined in this way, and control measures can be promptly instituted where needed. Of 17 pools of faeces of fleas from

serum-positive experimentally infected rats, 13 showed a positive complement-fixation reaction and four were negative, of 22 from serum-negative control rats 20 were negative and two were anticomplementary, of 30 from serum-positive commensal rats (rats living in association with man in houses, stores, etc.), 14 were positive, 11 negative and five anticomplementary and of 53 from serum-negative commensal rats, two were positive and 51 negative. The anticomplementary reactions may have been due to debris picked up with the fleas. The two positive results in the last test may be attributed to the recent arrival of the fleas from other rats. The test was found to be specific for typhus when examined with antisera for tick typhus, Q fever and mite typhus.

FAIRBAIRN (H.) & BURTT (E.). **The Infectivity to Man of a Strain of *Trypanosoma rhodesiense* transmitted cyclically by *Glossina morsitans* through Sheep and Antelope : Evidence that Man requires a minimum infective Dose of metacyclic Trypanosomes.**—*Ann. trop. Med. Parasit.* **40** no. 3-4 pp. 270-313, 3 figs., 1 fldg. chart, 49 refs. Liverpool, 1946.

Literature on the relationship of *Trypanosoma rhodesiense* to *T. gambiense* and *T. brucei* is briefly reviewed [cf. *R.A.E.*, B **17** 40-41; **18** 174; **22** 45; **25** 133; **29** 20, etc.] and it is shown that the hypothesis that *T. rhodesiense* is a strain of *T. brucei* that has acquired resistance to human serum, which is held by Duke, rests upon the assumption that if *T. rhodesiense* were maintained for a short period (1-2 years) in game it would lose its resistance to human serum and hence its infectivity to man and would revert to *T. brucei* and that the infectivity to man of *T. rhodesiense* is not a stable characteristic, is easily lost and is not of valid specific significance. An account is given of work from which it appears that these assumptions are false and in the light of which apparent anomalies in Duke's results can be logically explained.

The following is based on the authors' summary. A strain of *T. rhodesiense* isolated in 1934 and passaged by cyclically infected *Glossina morsitans*, Westw., through various animals [cf. **27** 18-19, etc.] was still infective to man after 10½ years. Maintenance in a single species of host resulted in a drop in infectivity to man, but this recovered after further maintenance in the same host species. Men who had not become infected after being fed upon by an infected fly frequently became infected when bitten again by the same fly after an interval of some weeks. Inoculation into human volunteers of definite numbers of metacyclic trypanosomes showed that the average man required 300-450 in order to be infected, but that some men needed more and some less. Some case-histories are recorded showing the high degree of resistance possessed by some individuals. A technique is described [**37** 137] by which the infection in a living fly was studied and data were obtained on the probable number of metacyclic trypanosomes extruded when the fly fed. It was found that the number was low and more constant in the first half of the fly's infected life, and high and more variable in the second half. The degree of infection of the salivary glands of *G. morsitans*, and hence its ability to inoculate an infective dose of trypanosomes, might vary from fly to fly in the same isolation, and from one isolation to another. The transmissibility of the strain (*i.e.*, its ability to invade the salivary glands of the fly) and its infectivity to man were significantly correlated. Transmissibility was influenced by the host from which the flies were infected, and also by the temperature conditions to which the flies were exposed [cf. **37** 135-136]. The virulence of a line kept in sheep decreased between 1934 and 1945, and yet its infectivity to man was still high in the latter year. The virulence of lines maintained in Thomson's gazelle and monkey increased between 1940 and 1945, while infectivity to man fluctuated over the same period. A number of atypical infections of man with *T. rhodesiense* are recorded and are compared with the carrier cases of trypanosomiasis reported

in the literature [25 17; 27 200-201]. It is concluded that there is no need to assume that these carrier cases are examples of *T. brucei* becoming acclimatised to man. The results of the inoculation of rats with positive blood from the arm-reactions and the blood of men infected from the various lines are recorded. It is suggested that *T. rhodesiense* maintained in sheep is assuming a *T. gambiense* character, which became apparent only after 10½ years' maintenance by cyclical transmission in a single species of host. Flies that had acquired their infection from man infected only a small proportion of the men on whom they fed. The failure of man to be infected by a fly carrying a known *T. rhodesiense* does not necessarily mean any alteration in the infective quality of the trypanosome. It is concluded that *T. rhodesiense* and *T. brucei* must be considered as distinct, and not convertible into one another.

TREDRE (R. F.). **The Rôle of *Anopheles gambiae* var. *melas* in the Transmission of Malaria in the Vicinity of Freetown Estuary, Sierra Leone, 1943.**—*Ann. trop. Med. Parasit.* 40 no. 3-4 pp. 380-420, 5 pls., 6 figs., 2 maps, graphs (1 fldg.), 14 refs. Liverpool, 1946.

Malaria is widespread in the territory around Freetown Estuary, Sierra Leone [cf. R.A.E., B 37 95], particularly in the villages, where children acquire immunity at a very early age. Its incidence among service-men stationed there was very heavy in 1940-41, but had decreased considerably in 1943. Cases were found to be contracted on ships moored in the estuary. Investigations on the local importance of *Anopheles melas*, Theo., as a vector, were undertaken in order to make possible the institution of sound control measures in a relatively short time for the protection of service-men. The literature on the morphological differentiation of *A. melas* and *A. gambiae*, Giles, is briefly reviewed [cf. 36 97, etc.]. For the purpose of this work, the character of the four-banded palp and the differences in the egg were used to distinguish them. Thomson's work on the breeding places of *A. melas*, which were found to be in the *Avicennia* mangrove zone [34 5-6] is reviewed, and an account is given of his investigations on the percentage of this species infected with malaria parasites in Freetown Estuary, the main results of which have already been noticed [34 5].

Mosquito catching stations (a room or rooms in an African dwelling) were instituted along the southern shore of the estuary in 1943, and the statistics from some 50 of them are appended. It is concluded that the predominant Anopheline is *A. gambiae*, which is most abundant in June and July. *A. melas* becomes more plentiful in proportion to *A. gambiae* from May to September, forming 25-33 per cent. of the total anopheline population, and maintains its production level from September to January while that of *A. gambiae* falls, so that in November and December *A. melas* is the more plentiful. Other Anophelines are comparatively insignificant. *A. melas* occurs in great numbers in the neighbourhood of circumscribed breeding-grounds. The level of wet-season production is continued into the first half of the dry season, and infiltration of villages in the upper reaches of the estuary creeks occurs during November, December and January. Production is intense where blood-meals are readily available, but the urban area of Freetown is not normally invaded. Thomson found that 90 per cent. of Anophelines caught in coastal villages on the northern shore were *A. melas* and that breeding by this species in the circumscribed *Avicennia* zones was comparable both in density and extent to that at the similar zone at Wellington on the southern shore.

The temperature throughout the year in the estuary zone is shown to fall within the limits of optimum conditions for the life-cycle of *Plasmodium falciparum* in the mosquito. Temperature and humidity are unfavourable for *A. melas* between January and April. Variations in density of production of this

species are related to tides [cf. 33 34], and great increases in numbers to high spring tides associated with moderate rainfall. Production is greatest in June, when the mean monthly relative humidity at 7 a.m. is 92 per cent. and the mean minimum temperature 76°F.

A permanent method of control is described. It consists of the construction of embankments and drainage ditches with sluice-gates to exclude tidal waters from breeding-zones [cf. 34 6] and development of the reclaimed area for agricultural purposes in such a way as to prevent its conversion into a prolific breeding ground for *A. gambiae*. The result of an experiment at Aberdeen has justified the application of this method to other similar breeding zones on the shores of the estuary. Where geographical conditions permit, breeding can be almost eliminated by removing the inhabitants of the area within two miles of a breeding zone. This is useful as a short-term measure for military purposes.

BAGSTER-WILSON (D.). **Notes on the Epidemiology of Malaria in the East Africa Command.**—*E. Afr. med. J.* 23 no. 9 pp. 258–272, 4 refs. Nairobi, 1946.

Data on malaria incidence in troops and on numbers of Anophelines taken in houses, etc., in various years between 1941 and 1945 are given for various localities in Kenya, Tanganyika, Northern Rhodesia and Nyasaland. The two vectors, *Anopheles gambiae*, Giles, and *A. funestus*, Giles, were present in all four territories. At Dar-es-Salaam, the ratios of the numbers of *A. funestus* and *A. gambiae* were 19 : 81 in the first quarter of the year, 4 : 96 in the second quarter and 50 : 50 in the second half. At Mombasa, they were 32 : 68 at first, but less than 10 : 90 after swamp drainage had been carried out. They were 11 : 89 at Nairobi, where sporozoites were found in two out of 805 females of *A. gambiae*. Glands of 191 females of *A. demeilloni*, Evans, 59 of *A. christyi*, Newst. & Cart., 49 of *A. funestus*, 42 of *A. cinereus*, Theo., 20 of *A. squamosus*, Theo., and nine of the typical form of *A. marshalli*, Theo., were all negative. The observations strongly suggested that the level at which *A. gambiae* can survive at a dangerous density in the Nairobi area is not more than 6,000 ft. At Lusaka, 78 per cent. of the two vectors were *A. funestus*. Adults were taken in only seven months of the year, though a small amount of breeding by *A. funestus* continues through the year. At Zomba, there were also several months during which few adults could be found. Numbers of the two vector species there were about equal over the year, but *A. funestus* formed 40 per cent. of the total during the rains and 70 per cent. after them.

It is concluded that though Anopheline control may be very effective in reducing malaria for the greater part of the year, effective control of larvae may fail to check the high seasonal incidence caused by *A. gambiae* in the more intensely malarious parts. Spraying to control adults in houses causes a considerable reduction in transmission, but used alone is less effective than control of larvae in the more hyperendemic areas. In these areas, effective control is obtained only if the population of *Anopheles* is reduced by 99 per cent.

GARNHAM (P. C. C.). **The Efficacy of insecticidal Sprays in Aircraft.**—*E. Afr. med. J.* 23 no. 9 pp. 272–277, 3 refs. Nairobi, 1946.

For five years, a routine test of the effectiveness of treatments made at Kisumu, Kenya, for the control of insects in flying boats has been made by exposing during spraying three females of *Aedes aegypti*, L., and three of *Mansonia (Taeniorhynchus) uniformis*, Theo., or *M. (T.) africana*, Theo., previously starved for 24 hours, in each of three cages, one placed on the rack

in the promenade cabin, one in the galley and one in the freight compartment on the upper deck. The mosquitos are examined 5, 10 and 15 minutes after their compartments have been sprayed, and are then removed and examined about 15 hours later. An efficient spray stuns all mosquitos in 15 minutes' exposure and kills all within 15 hours of exposure. The results of tests using several different insecticides, many of them of unspecified composition, are given in a table. They demonstrate the general effectiveness of the method used, but it was desired to investigate further the behaviour of mosquitos in the more inaccessible parts of the aircraft and under protected conditions. Tests with *Anopheles gambiae*, Giles, in gauze cages showed that it was possible for mosquitos to survive the flight from Kisumu to Mombasa in the wings of the aircraft, which were originally not treated, but that they were killed by spray directed through the wing hatch just before flight and drawn into the wing space by the vacuum valve. Tests on the effect on mosquitos concealed in remote places, such as the space behind panelling, of spraying with certain commonly used preparations at 38 or 46 cc. per 1,000 cu. ft. suggested that the higher dosage is necessary to reach such places. Mosquitos in the bullion locker, an airtight chamber in the floor of the cabin, were not killed by the higher dosage. Mosquitos protected by a layer of thin cloth were largely unaffected by insecticides, unless these were used in impracticably high concentrations. Females of *Aedes aegypti* remained inside coat-sleeves for periods up to an hour, even when the coat was roughly handled, and the possibility of their behaving in this way in aircraft constitutes a potential danger.

SABROSKY (C. W.). **Occurrence of Malaria Mosquitoes in southern Michigan.**—*Tech. Bull. Mich. agric. Exp. Sta.* no. 202, 50 pp., 2 maps, 14 refs. East Lansing, Mich., 1946.

In pioneer days, Michigan was regarded as highly malarious. In recent times, there have been only about 70 scattered cases per year, but this incidence, together with the return of service-men from infected areas, is deemed to constitute a constant threat. Larval and adult Anopheline surveys were therefore made in southern Michigan in 1943 and are described in this bulletin. The 951 adults collected and identified included examples of the four Anophelines (*Anopheles quadrimaculatus*, Say, *A. punctipennis*, Say, *A. walkeri*, Theo., and *A. maculipennis occidentalis*, D. & K.) known to occur in the State. Immature stages were found in 419 of the 624 stations searched, and 4,907 of the 7,276 larvae and pupae counted in the field were identified. *A. quadrimaculatus* was found to be breeding in a great variety of situations in both standing and running water, though with a preference for the former. It was collected from 352 of the 419 positive stations and formed 75.09 per cent. of the total identified. *A. punctipennis* formed 19.97 per cent. and showed a preference for running waters, but even in these it was not always more plentiful or widespread than *A. quadrimaculatus*. *A. walkeri* appeared to be numerically unimportant, but because its larvae may be thinly scattered over large areas of marsh or swamp, the samples probably do not give an accurate indication of its relative abundance. *A. m. occidentalis*, a northern form, was not taken in larval collections; it was represented by a few adults only. Keys for the separation of the larvae and adults of the four Anophelines and the pupae of all except *A. m. occidentalis* are appended.

STEELE (J. H.) & HABEL (K.). **Observations on an Outbreak of Encephalomyelitis in Panama.**—*J. Amer. vet. med. Ass.* 111 no. 847 pp. 263–268. Chicago, Ill., 1947.

An epizootic of encephalomyelitis occurred in horses in the western part of the Republic of Panama from July to December 1946, when the rainy season

ended. About 500 deaths were reported. The results are given of pathological examinations of two horses and a calf as a result of which the diagnosis was mycotic encephalitis in one case and encephalitis in the others. The virus of eastern equine encephalomyelitis was isolated from the brain of one of the horses. Virus was not isolated from any other animals. There were some suspected human cases but all gave negative results in serological examinations. Out of 11 other persons tested, serum from one had antibodies for eastern equine encephalomyelitis, but he had no history of recent illness. Five out of eight apparently normal horses and all of four that had recovered from the disease showed antibodies, as did two out of 20 fowls. One dog out of six was weakly positive. The epizootic spread in the direction of the prevailing wind, and its intensity fluctuated with rainfall and mosquito abundance. *Aedes taeniorhynchus*, Wied., *A. aegypti*, L., *Anopheles albimanus*, Wied., and *Mansonia* were taken in a trap baited with a horse, but the virus was not isolated from them. The catch was light as the rainy season was ending.

#### PAPERS NOTICED BY TITLE ONLY.

- PEREIRA BARRETTO (M.). **Catálogo dos flebótomos americanos.** [Catalogue of the American Species of *Phlebotomus*.]—*Arq. Zool. S. Paulo* **5** pp. 177–242, 9½ pp. refs. São Paulo, 1947.
- GJULLIN (C. M.). **A Key to the *Aedes* Females of America north of Mexico (Diptera, Culicidae)** [with notes on distinguishing characters].—*Proc. ent. Soc. Wash.* **48** no. 9 pp. 215–236, 2 figs., 10 refs. Washington, D.C., 1946.
- BEAMENT (J. W. L.). **The Formation and Structure of the Chorion of the Egg in an Hemipteran, *Rhodnius prolixus*.**—*Quart. J. micr. Sci.* **87** pt. 4 pp. 393–439, 13 figs., 37 refs. London, 1946. [*Cf. R.A.E.*, A **37** 110.]
- PLACKETT (R. L.) & HEWLETT (P. S.). **Statistical Aspects of the independent joint Action of Poisons, particularly Insecticides. I. The Toxicity of a Mixture of Poisons.**—*Ann. appl. Biol.* **35** no. 3 pp. 347–358, 7 figs., 14 refs. London, 1948. [See *R.A.E.*, A **37** 364.]
- PETTY (B. K.). **Residual Toxicity of chlorinated Hydrocarbon Insecticides** [tests with DDT, benzene hexachloride, chlordan and pentachlorophenol on surfaces present in buildings].—*Sci. Bull. Dep. Agric. S. Afr.* no. 291, [1+] 15 pp., 3 refs. Pretoria, 1948. [See *R.A.E.*, A **37** 399.]
- SHERMAN (M.) & NORTON (L. B.). **The Bioassay of Gamma Benzene Hexachloride** [using *Tribolium castaneum*, Hbst.].—*J. econ. Ent.* **41** no. 2 pp. 288–292, 2 figs., 8 refs. Menasha, Wis., 1948. [See *R.A.E.*, A **37** 393.]
- List of United States Patents granted Members of the Division of Insecticide Investigations, R. C. Roark, in Charge, for the Period July 1, 1927 to June 30, 1947.**—24 pp., multigraph. [Washington, D.C.] U.S. Dep. Agric., Bur. Ent., 1947.

WHITLOCK (J. H.). **Illustrated Laboratory Outline of veterinary Entomology and Helminthology.**— $10\frac{3}{4} \times 8\frac{1}{2}$  ins., iii+87 pp., 31 pls., multigraph. Minneapolis, Minn., Burgess Publ. Co., 1949. Price \$3.

This is the first part of a two-part laboratory guide to veterinary parasitology and is designed to help students to use the basic principles of taxonomy in the identification of common parasites of domestic animals. Brief notes are given on the morphology and bionomics of various groups of helminths that parasitise domestic animals and of Arthropods that parasitise or attack such animals or transmit diseases to them, and a key to mites of veterinary importance is included.

The bulk of the book consists of drawings of parasites and parts of parasites disposed on 31 full-page plates, of which eleven are devoted to Arthropods. It is intended that these illustrations be used for study in place of drawings made by the students themselves. They are not original, but most have been redrawn by a uniform technique. Accepted classifications are not always followed where convenience of instruction could be served by departing from them.

HOSKINS (W. M.) & CALDWELL jr. (A. H.). **Development and Use of a small Spray Chamber.**—*Soap & sanit. Chem.* **23** no. 4 pp. 143–145, 161, 163, 165, 167, 5 figs., 17 refs. New York, N.Y., 1947.

The following is substantially the authors' summary. A small almost horizontal cylindrical chamber, 12 ins. in diameter and 40 ins. long, has been used in tests with several contact insecticides against *Musca domestica*, L. The new feature consists in placing the fly cage under a hole in the bottom near the lower end of the chamber, opposite to the point of introduction of the spray. There is thus opportunity for the larger droplets to settle out before the spray cloud reaches the flies. Tests of the size of the droplets near the cage have shown a fairly narrow range, most of the total volume consisting of droplets approximately 10 microns in diameter. The largest deposit on individual flies is not more than twice the smallest and the range in variation is usually much less. Increase in deposit resulting from irritation of the flies and decrease as a result of knockdown during the spraying process were found with low and high concentrations of pyrethrins, respectively. Data are given to show the high reproducibility of toxicity measurements, and curves relating mortality probits to log. concentration or log. deposit of several insecticides are given for a range of volumes and concentrations. Curves somewhat concave upward were obtained in all cases. In addition to giving uniformity of deposit and toxicity, the chamber is very cheap to make, easy to clean, and lends itself to rapidity of operation. A slightly modified chamber is being used for screening tests with possible toxicants and for routine standardisation of household sprays.

SIMMS (B. T.). **Report of the Chief of the Bureau of Animal Industry, Agricultural Research Administration, 19[46–]47.**—84 pp. Washington, D.C., U.S. Dep. Agric., 1947.

The campaign for eradicating *Boophilus annulatus*, Say, and *B. a. microplus*, Can., from the southern United States by inspecting and dipping cattle, horses and mules was continued in the year ended 30th June 1947 [*cf.* *R.A.E.*, B **37** 89]. The reinfestation in Florida [*cf.* also **37** 170] proved to be more extensive than had been anticipated, and slight infestations were found in several additional counties; eradication in the quarantined areas continued satisfactorily. Ticks were again brought into the lower Rio Grande Valley of Texas from Mexico on stray or smuggled animals at a number of places. In Porto

Rico, where the tropical variety (*microplus*) is prevalent and it was necessary to treat sheep and goats on infested premises, efforts at eradication were resumed in February, 1947, when a systematic dipping campaign in the eastern third of the island was inaugurated. In continued experiments in Mexico [cf. 37 89-90] in the autumn of 1946 on the value of dips of DDT or DDT and BHC (benzene hexachloride) against *B. annulatus*, water-dispersible products were tried. They mixed readily with unheated well water and remained satisfactorily suspended during use. They settled rapidly during intervals, however, and vigorous stirring was necessary before dipping was resumed. Some toxicity was lost as dipping progressed, presumably through removal of suspended material by the cattle. Freshly prepared dips containing 0.5 or 1 per cent. DDT killed all ticks except for occasional engorged females that survived for up to three weeks. Dips containing 0.25 per cent. DDT and 0.25 per cent. BHC killed all ticks in five days, and cattle dipped in this suspension and returned immediately to infested pasture did not become reinfested for two weeks, and were not infested with ticks in all stages of development until five weeks after dipping. To effect eradication, the interval between dippings would have to be 4-5 weeks, so as to prevent the development of any ticks to maturity. Before starting on a trial over tick-infested ranges, 1,100 uninfested cattle highly susceptible to tick fever [*Piroplasma bigeminum*] were dipped in 0.66 per cent. DDT, and they were dipped again on arrival six days later. They were free of ticks after the journey and did not develop symptoms of tick fever during 60 days' stay in uninfested premises.

By the end of April 1947, nearly 3,200 cattle had been treated experimentally for the control of the spinose ear tick [*Otobius megnini*, Dugès] with a mixture of 5 parts by weight BHC, 10 parts xylene and 85 parts pure steam-distilled pine oil. This is easy to prepare and use, is non-irritating and leaves the ears free of débris. It destroyed all the ticks in the ears of heavily infested cattle and prevented fresh infestation for more than 17 but less than 24 days. The oiling device used to apply it is described. Experimental work on the control of cattle grubs [*Hypoderma*] on an area basis was continued in Colorado as in previous years. In 1946-47, 263 cattle were treated with a standard rotenone wash for the third successive year. The average number of larvae per animal was 2.6. In a large group, of which these formed a part, it had been 17 in 1945 and 5 in 1946. Moreover, in 1947, nearly 27 per cent. of the cattle were entirely free of larvae. In a second group of 1,081 cattle, treated in 1946-47 for the second successive year, the average number of larvae per animal was reduced from 10.5 in 1946 to 3.4.

Six species of grass mites, not previously known to serve as intermediate hosts of *Moniezia expansa*, were found to be infested with the larval stages of this tapeworm. One of them, *Galumna virginiensis*, Jacot, appeared to be the chief intermediate host in the neighbourhood of Beltsville, Maryland. *Scheloriobates laevigatus*, Koch, was the principal one in western South Dakota. In investigations made at Beltsville, it was calculated that the top layer of an acre of turf on a permanent pasture to a depth of one inch contained about six million mites of one species that can transmit *M. expansa* to sheep. Not all were infested, but the infested mites on a single acre may harbour about a million tapeworms. The numbers of larvae in individual mites ranged from 1 to 12.

DDT in an emulsified oil solution was shown in 1944-45 to give effective control of lice on pigs [36 57]. As it was feared that DDT in oil might be absorbed through the skin and deposited in the fat, and so poison persons eating the pork or lard, experiments were made with a suspension of DDT in water. Some 230 pigs were dipped in 400 U.S. gals. of a 0.75 per cent. suspension of DDT, the vat being replenished with 60 U.S. gals. suspension after about half the animals had passed through it. No living or dead lice were found

1-60 days after dipping, but eggs adhered to the hair for as much as four weeks. After 60 days, new pigs that had been sprayed with the used dip remaining in the vat were introduced into the herd. A final inspection, 194 days after dipping, of ten pigs selected at random showed only one living louse. In a similar test carried out in the spring of 1947, however, five pigs examined 28 days after treatment each bore a few living lice.

In eight tests involving 2,240 fowls, vapour from BHC applied by spraying or painting the roosts and other structures of hen houses with solutions or aqueous suspensions containing 0.55-4 per cent.  $\gamma$  isomer was effective against heavy infestations of the body louse [*Eomenacanthus stramineus*, Nitzsch] and the fluff louse [*Goniocotes gallinae*, Retz.]. All lice were killed in 17-66 hours, according to temperature, and none hatched during observation periods of 34-110 days. There was no indication that the vapours had any detrimental effect on the birds or on egg production. The lowest concentration (0.55 per cent.  $\gamma$  isomer) destroyed all body lice on 66 hens, and these birds remained free of infestation during an observation period of 39 days. The suspension was as effective as the solutions.

EDDY (G. W.) & BUSHLAND (R. C.). **Compounds more toxic than DDT to Body Lice.**—*J. econ. Ent.* **41** no. 3 pp. 369-373, 6 refs. Menasha, Wis., 1948.

An account is given of work in which five new organic insecticides were tested by various established laboratory procedures in direct comparison with purified DDT against *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.). When the materials were applied to woollen cloth (by dipping it in acetone solution and allowing the solvent to evaporate) and lice were exposed on the cloth in beakers for 24 hours [*R.A.E.*, B **34** 44-45], the most toxic were  $\gamma$  BHC (benzene hexachloride) and technical chlordan. These gave 63 and 23 per cent. kill, respectively, at a concentration of 0.0005 per cent. and all surviving lice were affected. Toxaphene (chlorinated camphene) and crude BHC (containing about 10 per cent.  $\gamma$  isomer) gave 30 and 50 per cent. kill, respectively, at 0.0025 per cent., with all survivors affected, but did not kill or adversely affect all lice at 0.001 per cent. DDT and 2-pivalyl-1,3-indandione did not adversely affect all lice at 0.005 per cent. All lice exposed on cloths impregnated with 1 per cent. crude or  $\gamma$  BHC or 2-pivalyl-1,3-indandione were paralysed within 15 minutes. Chlordan tested in the same way paralysed all the lice within three hours and most of them in one hour, but toxaphene required five hours and DDT six hours to do so.

In arm-and-leg tests [*cf.* **33** 109], DDT was ineffective as a 0.05 per cent. powder against lice confined for 24 hours in sleeves each treated with 3 gm. powder, but the other materials killed all or practically all lice at that concentration. Only  $\gamma$  BHC killed or adversely affected all lice at 0.01 per cent. As 1 and 5 per cent. powders applied to sleeves worn constantly, both forms of BHC lost their insecticidal effect much more rapidly than the other materials. The effectiveness of chlordan, toxaphene and 2-pivalyl-1,3-indandione lasted about as long as that of DDT. These compounds all gave almost complete kill of lice in 48 hours 12 days after application at 1 per cent. and 22 days or more after application at 5 per cent. Sleeves of cotton underwear cloth impregnated with 2 per cent. of their weight of the insecticides were compared for resistance to laundering. Toxaphene, which was the most resistant, remained lethal to lice after four boilings of 15 minutes each in a 1 per cent. soap solution each followed by four rinsings in cold water. DDT lasted almost as well, and was superior to chlordan. Crude and  $\gamma$  BHC withstood only one boiling and 2-pivalyl-1,3-indandione none.

It is concluded that neither form of BHC is sufficiently persistent to rank with DDT for practical use in louse powders, and its odour is another objection. Further work on the toxicity of chlordan and toxaphene to man is necessary before either could be recommended, and 2-pivalyl-1,3-indandione is not considered suitable for use on human skin except at very low concentrations.

GLASGOW (R. D.) & COLLINS (D. L.). **Ecological, economic and mechanical Considerations relating to the Control of Ticks and Rocky Mountain Spotted Fever on Long Island.**—*J. econ. Ent.* **41** no. 3 pp. 427–431, 14 refs. Menasha, Wis., 1948.

Tick-borne spotted fever has been reported in the United States from 47 of the 48 States, but in New York, it is known to be endemic only in the two eastern counties of Long Island and is rare in the more western of the two [*cf. R.A.E.*, B **35** 129]. From 1912 to the end of 1947, 132 cases with 22 deaths were reported from Long Island. Prophylactic vaccination is widely used by residents of the endemic areas and is probably the most economical means of protection, but the persistence of the disease in enzootic form constitutes a continued hazard for unvaccinated residents and visitors. The only alternative for the protection of these appears to be a substantial reduction of the population of the local tick vector (*Dermacentor variabilis*, Say). Eradication seems to be unnecessary. The incidence both of the disease and of the tick decreases westwards to a point beyond which no cases of the disease are known to have been acquired locally, presumably because there are too few ticks. The hypothesis is complicated by the enzootic nature of the disease and by the fact that the infected tick, as well as remaining a carrier throughout life, can transmit the causal rickettsia through the eggs, though only portions of the next and succeeding generations are thus infected. Ovarial transmission to only a part of the progeny suggests that the tick species may be self-cleansing. Certain erratic features in the endemicity of the disease suggest also that some ecological factor may help to hasten such cleansing of the tick population locally. However, a working hypothesis that a sufficient reduction in numbers of ticks where they are abundant should result in a corresponding decrease in the risk of spotted fever in man and the suppression of the enzootic through the local extinction of the pathogen seems to be justified.

Testing of acaricides was continued in 1946 and 1947 [*cf. loc. cit.*] on laboratory and field scales. In both years, heavily infested plots 160 acres in extent were sprayed from the air with DDT and in 1946 one of them was sprayed a second time. A tick-proof enclosure one yard square near the centre of each plot was heavily stocked with ticks before spraying. A similar wire enclosure containing ticks was set up at a distance as a control. Smaller plots stocked with collected ticks were treated experimentally with sprays and dusts from the ground. A 5 per cent. solution of DDT in No. 2 fuel oil applied from the air at an average rate of 2 U.S. gals. (0.8 lb. DDT) per acre gave adequate control of ticks in a heavily infested area, but aerial application is recommended only where it may advantageously be combined with mosquito control or a similar operation or where a large area inaccessible from the ground is crossed by many tick-infested paths or trails. It was estimated that through the tendency of the ticks to congregate at the edges of paths and roads [*cf. 29* 137 ; **37** 37], 90 per cent. of the population was sometimes concentrated in less than 1 per cent. of the area. In some places, more than ten ticks per linear foot were assembled within a few inches of a trail, yet few could be found three feet from it. This concentration of population and the exposed position of the ticks while awaiting hosts greatly simplifies control. Sprays and dusts of DDT and BHC (benzene hexachloride) applied to the narrow infested zones destroyed the assembled ticks almost completely, with no danger to wildlife. DDT applied at 1 lb. per acre in dust,

solution, emulsified solution or suspension to a strip 4 ft. wide on each side of a highway or trail (about 1 lb. per mile) gave good experimental control at a lower cost than any other acaricide tested. BHC at 1 lb.  $\gamma$  isomer per mile almost completely destroyed the ticks but was more expensive. In view of the difficulty of adhering to an exactly specified dosage, 1-2 lb. per acre is recommended. Attention is called to aspects of the problem requiring further study.

ROTH (A. R.) & LINDQUIST (A. W.). **Ecological Notes on the Deer Fly at Summer Lake, Oregon.**—*J. econ. Ent.* **41** no. 3 pp. 473-476, 1 graph, 1 ref. Menasha, Wis., 1948.

Preliminary studies on the ecology of *Chrysops discalis*, Will., were carried out in 1946 and 1947 in the vicinity of Summer Lake, Oregon, where this Tabanid is a severe pest of man and livestock [*R.A.E.*, B **35** 97]. Milk production in the district is reported to decline by 40-50 per cent. during the season of fly activity. Adult populations, as determined by 32 swings of the net, were greatest in the latter part of July and the first part of August. Eggs are laid on sedges (*Scirpus americanus* and *S. paludosus*) at the northern end of the lake and were never found in soil whether wet or dry, but oviposition also occurred on wire gauze, glass, cardboard and other objects placed in the water along the shore. In a few days, 30,000 egg masses were laid on a board 12 ft. high and 6 ins. wide fixed as a stake at some distance from the sedges. Each egg mass contains about 450 eggs. Unpainted stakes and stakes painted red were much more attractive for oviposition than stakes painted in any of 11 other colours. Enormous numbers of flies were caught on stakes treated with non-drying adhesives (butylene polymers) and exposed in the lake near the shoreline. In good weather, stakes were covered with flies in a few hours. On one 12 ft. high and 6 ins. wide, 16,872 flies were trapped in two days in August.

The larvae are found in the bottom mud of the lake to a depth of about 4 ins., and are distributed fairly regularly over the lake during the spring. The number per sq. ft. ranged from 0 to 133. Full-grown larvae were found from 12th June to 26th August. Most of them were concentrated along the shorelines, probably having been transported there by the wind after they had come to the surface, which they do during the night. They burrow into the mud at the shoreline, and tunnel upwards, opening an emergence tunnel just before pupation, which takes place near the surface in damp but not wet soil along the shore. Adults emerged for 25-30 days in cages sunk into the soil along the shore and allowed to remain undisturbed. The average number of flies that emerged per square foot was 3.04 in 1946 and 0.21 in 1947. The flies stay near the pupal cases for 10-15 minutes after emergence and then fly to vegetation, never to the water.

BROMLEY (S. W.). **Mosquito Spraying with DDT and the Two-spotted Mite.**—*J. econ. Ent.* **41** no. 3 p. 508. Menasha, Wis., 1948.

In July 1947, an attempt was made to control mosquitos (*Aedes canadensis*, Theo., and *A. vexans*, Mg.) by spraying the vegetation surrounding a small pond and bordering a car park in a wooded area in Connecticut with a suspension of wettable DDT powder containing 1 lb. actual DDT to 100 U.S. gals. water. The effect on the mosquitos was extremely unsatisfactory, relief from biting lasting only a few hours, and heavy infestation by Tetranychid mites developed on the sprayed vegetation.

HAGMANN (L. E.) & BARBER (G. W.). **Overwintering Habits of *Phaenicia sericata* (Mg.).**—*J. econ. Ent.* **41** no. 3 p. 510, 1 ref. Menasha, Wis., 1948.

In the first week of November 1947, many full-grown larvae of a brood of *Lucilia* (*Phaenicia*) *sericata*, Mg., which was being reared in carcasses in an

unheated greenhouse at New Brunswick, New Jersey, failed to form puparia and remained inactive in the soil. They would not feed or pupate when taken indoors. Examination of the sand and earth floor of the greenhouse on 12th March 1948 revealed many larvae of various sizes in the upper inch. These formed puparia when taken indoors, and adults emerged in about a week. Of 263 larvae collected, 242 pupated and 240 adults emerged. *L. sericata* was also being reared in carcasses on soil out of doors during the first two weeks of November 1947. Examination of the soil showed the presence of many larvae but no puparia on 19th March and both larvae and puparia on 26th. They were in cells at distances varying from several inches to several feet from the carcass and were more plentiful in soil free from roots. Almost all were in the top inch. Larvae pupated when brought indoors, and adults emerged within about a week. Of about 200 individuals collected, 176 formed puparia and 134 adults emerged. At the outdoor position, adults were observed on 9th April and were plentiful on 20th. The winter of 1947-48 was severe. These observations confirm earlier ones [R.A.E., B 18 158] that larvae of *L. sericata* hibernate in the soil [cf. also 27 83].

HASEMAN (L.). **An authentic Case of Ox Warble in Man.**—*J. econ. Ent.* 41 no. 3 p. 515. Menasha, Wis., 1948.

There are many records of myiasis in man due to *Hypoderma* [R.A.E., B 24 182; 27 269; 33 4] and *Gasterophilus* [23 77; 27 144; 31 127, etc.], and it appears that each of these types of parasite has its peculiar pattern of attack in man. A description is given of a case of infestation by a first-instar larva of *Hypoderma lineatum*, Vill., in a boy in Missouri, in which the usual course was followed. In the middle of December 1944, swelling, stiffness and pain were noticed in the thigh for about a week. Similar symptoms later appeared in the ankle and calf of the leg for two days, the knee for three days, the upper part of the thigh, the hip, the back for two days, the back of the neck for three days and finally the back of the head [cf. 23 51-52] for 4-5 days. It was then the middle of January. Following the application of heat, the larva was pressed out of a boil-like swelling. While in the head, it caused intense pain. It must have been moving about in the body for some time before pain was first felt.

The boy used to drive the cattle in from pasture, usually wearing rubber boots to do so, but did not have any other close association with them. It is supposed that a newly hatched larva got on to his clothes during brief contact with one of the cows. It is clear that those who are regularly associated with cattle should take precautions to escape contact with newly hatched larvae, particularly when the females are on the wing and ovipositing.

HAMMAN (R. E.). **Factors involved in poisoning German Roaches by exposing them to Surfaces treated with Chlorinated Hydrocarbons.**—*J. econ. Ent.* 41 no. 3 pp. 516-517. Menasha, Wis., 1948.

In testing certain insecticides, it is necessary to consider what is the minimum dosage for maximum paralysis, what is the minimum exposure time with this dosage for maximum paralysis, and whether movement over a treated surface is necessary for paralysis. Tests are described, in which these points were investigated for technically pure DDT, chlordan and toxaphene (chlorinated camphene) and the  $\gamma$  isomer of BHC (benzene hexachloride) when used against the most resistant stage (the fourth instar) of *Blattella germanica*, L. A solution

of the insecticide in acetone was swirled round inside a glass jar until the acetone evaporated, leaving a uniform coating of insecticide. Lids were not used, and the cockroaches were prevented from escaping by a barrier round the mouth of the jar. When it was desired to keep them immobile on a treated surface, they were first anaesthetised with carbon dioxide. Ten cockroaches were used to each test jar, and 3-6 replications were made of each test. All insecticides were fresh when used, and the dosages given are the deposits in mg. per 1,000 sq. cm.

The results indicated that the minimum doses required for maximum paralysis were between 10 and 25 mg. for DDT, between 0.5 and 1 mg. for chlordan, and between 0.1 and 0.5 mg. for  $\gamma$  BHC, the curves for considerably higher doses showing very little difference. The experiments with toxaphene showed no sharp drop in the rate of paralysis, but its toxicity compared favourably with that of DDT.

Tests to determine the exposure time after which no further increase in paralysis rate occurs indicated that this period was about 1 hour for DDT at 25 mg. (the curve for 80 minutes being similar but those for 15 and 45 minutes showing a definite decrease), between 12 and 20 minutes for chlordan at 1 mg. (an increase to a dosage of 5 mg. accelerating paralysis but not enough to be worth the extra insecticide), and 10 minutes for  $\gamma$  BHC at 0.5 mg. Previous tests where cockroaches were continuously exposed to toxaphene indicated that the compound might be highly effective, but results in the present tests were obvious only with exposures greater than one hour.

In comparative tests with active and immobilised cockroaches, results with DDT and chlordan were practically identical under the two conditions. Results with  $\gamma$  BHC indicated a very high initial rate of paralysis with some recovery after a time. The treated cockroaches showed a higher rate of paralysis than those allowed to run freely over the surface. This indicates a possible fumigating effect, aided by increased respiration from the carbon-dioxide atmosphere. Control cockroaches exposed to carbon dioxide showed no ill-effects.

GRAHAM (O. H.) & EDDY (G. W.). **Persistence of Chlorinated Camphene as a Fleece Worm Larvicide.**—*J. econ. Ent.* **41** no. 3 p. 521, 1 ref. Menasha, Wis., 1948.

Sheep artificially infested with larvae of various blowflies (chiefly *Callitroga macellaria*, F., and *Phormia regina*, Mg.) were treated in Texas in 1947 with benzene solutions, water suspensions and emulsified solutions of toxaphene (chlorinated camphene), chlordan, BHC (benzene hexachloride), DDT, x-chlorphenothioxin and diphenyl. Treatments were made on the second and third day after the implantation of newly hatched larvae on the sheep. Each material was used at 2 per cent., and x-chlorphenothioxin also at 5 per cent., DDT at 7 per cent. and diphenyl at 10 per cent. A wetting agent was included in all solutions except 10 per cent. diphenyl. Toxaphene was the most promising of the six materials. Eight of the ten sheep treated with it were protected against artificial reinfestations similar to the original one for the entire time they were in test (55-82 days), during which period 10-17 implantations were attempted on each. Of the other two, one resisted ten implantations during 63 days and one six implantations during 46 days. Chlordan and  $\gamma$  BHC (more than 83 per cent. pure) protected sheep for relatively long periods, but not for so long as toxaphene. Mixed isomers of BHC and the other test materials were less effective. There was no external evidence that any of the animals were affected adversely by any of the treatments.

HADDOW (A. J.) & MAHAFFY (A. F.). **The Mosquitoes of Bwamba County, Uganda. VII. Intensive Catching on Tree-platforms, with further Observations on *Aedes (Stegomyia) africanus*, Theobald.**—*Bull. ent. Res.* **40** pt. 2 pp. 169–178, 10 refs. London, 1949.

In this continuation of an account of research on the transmission of yellow fever in Bwamba County, western Uganda [cf. *R.A.E.*, B **36** 205, etc.], an unsuccessful attempt to isolate the virus from over 4,500 mosquitos of the genera *Aedes* and *Mansonia* (*Taeniorhynchus*) caught in two forest areas, including over 3,000 examples of *A. africanus*, Theo., is described. *A. africanus* was represented in a pool of 12 species from which the virus was isolated in 1944 [37 151], and there was evidence that it was the species most likely to be involved in the transmission of the disease among monkeys in the area [cf. 35 68]. It survives the dry season in the adult stage in forested and wooded parts of Uganda, is an efficient vector in the laboratory and shows a well-marked peak of biting activity just after sunset in the forest canopy, which is its preferred habitat.

The following is based on the authors' summary. Intensive series of catches were carried out during 11 weeks in April–June 1945 at Mongiro and Mamirimiri in Bwamba County, mostly on platforms in trees during the sunset period. The results confirmed that *A. africanus* is the dominant arboreal mosquito of this period. Of 3,776 mosquitos of over twenty species caught in the forest canopy (50–60 ft. above ground) at Mongiro, 2,113 were *A. africanus*, 302 were *Mansonia* (*Taeniorhynchus*) *africana*, Theo., an experimental vector [18 147] and 698 were *Anopheles gambiae*, Giles. Two individuals of *Aedes aegypti*, L., were taken in the trees of Mamirimiri and 13 actually in the canopy at Mongiro. Both areas are primary rain-forest, with very few native huts, none of them within half a mile of a catching station. *A. africanus* is peculiarly susceptible to the influence of weather [cf. 35 68]. Low temperatures at sunset may partly or even completely inhibit biting at that time. On these occasions, the numbers biting during the later night hours are usually above normal.

The methods of inoculating triturated mosquitos into laboratory animals in the field and of feeding *A. africanus* on rhesus monkeys [*Macaca mulatta*] in captivity are described. Females of this species engorge readily and with remarkable speed. The proboscis was usually inserted at the moment of alighting, and feeding was generally completed within half a minute. The close relationship between *A. africanus* and *A. luteocephalus*, Newst., is discussed. The authors believe that the differences between these mosquitos do not warrant specific rank for *A. luteocephalus*, more particularly as intermediate forms have been found.

MACLEOD (J.). **The Climatology of Blowfly Myiasis. II. Oviposition and daily Weather Indices.**—*Bull. ent. Res.* **40** pt. 2 pp. 179–201, 2 figs., 15 refs. London, 1949.

The following is substantially the author's summary of this second paper of a series [cf. *R.A.E.*, B **36** 17]. Records of oviposition by blowflies (probably chiefly *Lucilia sericata*, Mg.) on test groups of sheep in Hertfordshire over a period of five years (1936–1940) were examined for relation between the rate of oviposition per day and daily weather as indicated by the conventional meteorological indices. Some analytical considerations are discussed. There was a definite correspondence with the maximum shade temperature for the day. The relation was not straight-line, the slope changing between 18 and 20°C. [64.4 and 68°F.]. The association with the minimum temperature was not

significant. Insolation, as measured by the difference between maximum temperatures in the sun and shade, was positively associated with oviposition. The evaporating power of the air, the saturation deficit, and the ratio of the daily totals of rain and evaporation, indicated a low negative correlation with humidity; the rainfall correlation was barely significant. The association was in no instance statistically reliable.

For given temperatures, higher insolation was associated with greater oviposition. This intereffect was not affected by the rain factor. High saturation deficit and high evaporation were similarly positively associated with oviposition, but the evaporation effect was found to be true only for days when rain fell. Variation of the precipitation index or of the precipitation/evaporation ratio appeared to result in temperature having differential effects; the optimum temperature was apparently lower with the lowest precipitation or precipitation/evaporation value than with higher categories.

The hypothesis is tentatively offered that oviposition, for standard conditions of stimulus, is primarily associated with temperature, the regression of daily total oviposition on the maximum temperature being approximately linear between 13 and 26°C. [55.4 and 78.8°F.]. Desiccating effects normally cause curvature of the regression at temperatures above 20°C., the optimum maximum temperature becoming less with decreasing available moisture, expressible as daily precipitation/evaporation. For given air-temperature and moisture conditions, the level of response is positively associated with intensity of insolation as measured by the difference of daily maxima of sun and air temperatures.

WHITNALL (A. B. M.) & BRADFORD (B.). **An arsenic-resistant Tick and its Control with "Gammexane" Dips. Part II.**—*Bull. ent. Res.* **40** pt. 2 pp. 207–226, 6 figs., 3 refs. London, 1949.

The rapid spread of the arsenic-resistant strain of *Boophilus decoloratus*, Koch, in South Africa [R.A.E., B **35** 64] has seriously affected a large and important cattle-rearing area, though certain climatic conditions appear to be necessary for the resistance to manifest itself or for the strain to survive. In the Bathurst area of the Eastern Cape, heavy tick infestation coupled with severe drought in 1945 and the early part of 1946 caused the death of many cattle despite regular weekly treatment with arsenical dips containing 0.16 per cent.  $\text{As}_2\text{O}_3$ . An account is given of laboratory tests in which preparations, mainly of BHC (benzene hexachloride), likely to be suitable for use as dips were compared and of field experiments made between March 1946 and April 1947 to evaluate further the effectiveness of  $\gamma$  BHC (gammexane). Calculations of  $\gamma$  isomer content are based on the assumption that the BHC used in most of the preparations contained 10 per cent., whereas it actually contained more (up to 14 per cent.). The technique used in the laboratory tests was that described in the previous paper of this series [36 21], and the same technique was employed to supplement chemical analysis of samples of dip, in which only total BHC was estimated. The *in vitro* tests were made on 20,000 adult female ticks. Emulsified oil solutions of BHC seemed more active than suspensions prepared from dispersible powders or pastes, but all tests indicated that 0.005 per cent.  $\gamma$  isomer should give satisfactory control in the field. In a comparative test in which the amount of  $\gamma$  BHC in the emulsion varied only from 0.0044 to 0.0052 per cent., control rose from 54 to 100 per cent. as the ratio of oil to  $\gamma$  BHC fell from 313 : 1 to 10 : 1. Laboratory tests with larvae showed that  $\gamma$  BHC had a persistent action against this stage and was very toxic to it. Excellent control of larvae in the field could be anticipated. DDT was inferior to BHC and was not included in the field tests.

In preliminary spraying tests with an emulsified solution, 0.0073 per cent.  $\gamma$  BHC caused no injury to cattle, and 0.003 and 0.0045 per cent. had a rapid action on ticks and lice. When used weekly, the sprays kept the cattle free from *B. decoloratus* except for reinfesting larvae. In extensive dipping experiments, six tanks were filled with emulsions containing  $\gamma$  BHC and three with suspensions made from dispersible powders, and cattle were dipped weekly except for a few left undipped as controls. Chemical analyses of samples of dipping fluid indicated a drop in the  $\gamma$  isomer content, proportionate to the number of cattle dipped. Biological tests confirmed this. The fall in  $\gamma$  isomer content was due to removal of the BHC on the skin and hair of the animals, not to chemical decomposition. The tests also showed that normal replenishments raised the toxicity of the dip again and maintained it at sufficient strength to control *B. decoloratus* in the field, though they did not keep the content of  $\gamma$  BHC at a level approaching 0.005 per cent. Scrapings of ticks from the necks of dipped and undipped cattle showed that all cattle picked up larvae of *B. decoloratus* from the pastures, but those on dipped cattle were smaller and seldom developed into nymphs and adults. In most cases, weekly dipping for 6-8 months brought the arsenic-resistant tick under control, for after that time the undipped animals were almost as free from infestation as the dipped ones. On one ranch in the Eastern Cape, the percentages of cattle that died in 1945, 1946 and 1947 were 35.32, 16.66 and 4.59, respectively. Mortality fell rapidly in May 1946, soon after dipping with BHC had begun, though the drought continued. Reports of similar results were received from all over the Eastern Cape and Natal.

*In vitro* and field tests indicated that  $\gamma$  BHC was also effective against *Rhipicephalus evertsi*, Neum., *R. appendiculatus*, Neum., *A. hebraeum*, Koch, *Haemaphysalis silacea*, Robinson, and *Hyalomma* spp., other ticks that were found on cattle in the district, but hand dressing and dipping more frequently than once a week might be necessary to control all these in the field. *Ixodes pilosus*, Koch, which also occurred on the cattle, seemed to be resistant to  $\gamma$  BHC but, like the others, readily killed by arsenic. Lice were eliminated by 3-4 weekly dippings in  $\gamma$  BHC.

RIBBANDS (C. R.). **Studies on the Attractiveness of Human Populations to Anophelines.**—*Bull. ent. Res.* **40** pt. 2 pp. 227-238, 4 figs., 12 refs. London, 1949.

The attractiveness of human populations of various sizes to female Anophelines was compared in 1941 at Aberdeen, Sierra Leone, in huts visited by *Anopheles melas*, Theo., and in 1942 at Krabonekrom, Gold Coast, in an area infested with *A. funestus*, Giles, and *A. gambiae*, Giles. Africans slept in the huts and the mosquitos attracted to them each night were killed by pyrethrum sprays and counted. In one experiment at Aberdeen, in which three Africans slept in separate huts, the total catches from each between 2nd August and 26th September were not dissimilar, but there were periods of several successive days during which one or other of the men attracted considerably more than either of the others. Statistical examination indicated that these large catches occurred in groups much more often than would be expected on the hypothesis that a large catch on one day was unrelated to the size of the catch on adjacent days. Deodorisation by washing [*cf. R.A.E.*, B **30** 183] is shown not to be a satisfactory explanation of the fluctuations in attractiveness. The results are thought to prove that mosquitos can discriminate between the attractiveness of individuals and that there are marked fluctuations in the attractiveness of the same individual.

To measure the relative attractiveness of one man and several men, pairs of huts were used at Aberdeen between 2nd October and 27th November 1941

and at Krabonekrom from 3rd February to 16th March 1942, one man sleeping in one hut of each pair and three in the other. The ratio between the numbers of *A. melas* attracted by one man and by three at Aberdeen was 1 : 2.72 and the corresponding ratios at Krabonekrom were 1 : 2.28 for *A. funestus* and 1 : 2.38 for *A. gambiae*. For a short time, discrimination of females was reduced by the masking odour of cut and withering bush [34 157–158]. Differences between these results and those of Haddow in Kenya [30 183], which showed less marked discrimination, are attributed to the fact that Haddow's mosquitos were hand-caught from unsprayed huts and presumably included some that had reached the huts by random wandering, whereas the huts in the present experiments had probably been made repellent by the pyrethrum to all but hungry females that had detected a source of food. This hypothesis is borne out by the fact that in Haddow's experiments *Mansonia* (*Taeniorhynchus*) *africana*, Theo., and *M. (T.) uniformis*, Theo., which do not enter houses for shelter, readily discriminated between one and two natives (whereas *A. funestus*, and *A. gambiae* did not) and catches were approximately proportional to the number of natives. The present evidence modifies the view that female Anophelines seldom enter empty huts for shelter only [34 91] and suggests that some are first attracted to huts as resting places, but become hungry and seek food later in the night, and depart if they fail to find it.

The destruction of Krabonekrom, a village of 26 huts, because it was a source of malaria infection for a military hospital, increased by only 25–50 per cent. the proportion of mosquitos caught in two huts that were allowed to remain on the site in relation to catches in huts situated between the village and the breeding ground. This indicated that most of the mosquitos that visited the village were attracted to it from a distance. There was a much larger temporary increase in the number of mosquitos visiting the remaining huts, especially on the second, third and fifth days after the village had been removed. The reason for this is not known. The influence of a lingering scent and the return of old mosquitos to known localities are suggested as possible explanations.

In spite of the evidence of discrimination, the present experiments provide additional support for the view that the number of Anophelines per person in a community tends to be in inverse ratio to the size of the community.

FELDMAN-MUHSAM (B.). **Hibernation of *Hyalomma savignyi* (Ixodidae) in Palestine.**—*Bull. ent. Res.* 40 pt. 2 pp. 305–306, 2 refs. London, 1949.

During field work in Palestine in the winter of 1945–46, the only ticks found were a few adults (some engorged) in the Jordan Valley and the Negeb. To determine whether other stages can survive and hibernate at low temperatures, experiments were made with *Hyalomma savignyi*, Gerv., the commonest species in Palestine. They were carried out in a chamber with a constant temperature of 32°C. [89.6°F.] and a relative humidity of about 80 per cent., in a cupboard in an unheated corridor with a mean temperature of 20°C. [68°F.] in November falling to 16°C. [60.8°F.] in March and rising to 22°C. [71.6°F.] in June and a relative humidity of 40–50 per cent., and out of doors where the mean monthly temperature was 16°C. in November falling to 7.6°C. [45.68°F.] in February and rising to 20°C. by May.

Five engorged females collected a fortnight earlier from camels were placed in each situation on 6th November, 1945. Two of those in the controlled chamber began to lay eggs after four and seven days, and the other three after 22–26 days. Those in the cupboard began to oviposit in the spring, the first starting in the middle of March. The females out of doors did not lay until about 1st June. Eggs left at 32°C. hatched in 14–22 days. Eggs transferred from the chamber to the cupboard when 10–13 or 8–10 days old hatched in 20

and 34 days, respectively. Some transferred when 1–3 days old survived about seven weeks, while others developed fairly well but died in the middle of February. Eggs from the chamber put out of doors when 10–13 or 8–10 days old developed very slowly and died after about 130 days. Those transferred at 1–3 days old died after 60 days. Larvae, 2–4 days old, transferred from the chamber to the cupboard or out of doors lived for about one and two months, respectively. Larvae hatching from one batch of eggs normally form a cluster to protect themselves against unfavourable external conditions. At 17.5°C. [63.5°F.], unfed larvae live on an average 14 days at a relative humidity of 20 per cent. and 163 days at 95 per cent. Under the latter conditions, one survived 241 days. Unengorged nymphs put out of doors on 3rd February were still alive at the end of April. Engorged ones, kept for four days in the chamber after leaving their host and transferred to the cupboard on 25th January, developed normally and gave rise to five adults after 50 days and nine more after 125 days. Engorged nymphs transferred outdoors reached the adult stage only on 1st July. Engorged larvae kept at 17.5°C. moulted to nymphs in 30–50 days, irrespective of humidity, but nymphs kept at this temperature lived for a very long time without moulting if humidity was high, and most eventually died. The nymphal stage of those that finally moulted lasted 400–500 days. At a lower relative humidity, about 40 per cent. of the nymphs produced adults after a nymphal period lasting 114–348 days.

MOGGRIDGE (J. Y.). *Climate and the Activity of the Kenya coastal Glossina.*—*Bull. ent. Res.* 40 pt. 2 pp. 307–321, 6 figs., 6 refs. London, 1949.

An account is given of a study of the effect of climate on the activity of *Glossina pallidipes*, Aust., *G. austeni*, Newst., and *G. brevipalpis*, Newst., at Kilifi on the Kenya coast. The climate of Kilifi is described. It is influenced by the trade winds, and rain usually falls in every month of the year. In this work, there are recognised a wet season from April to June or May to July, a humid season from June or July to October and a dry season from November to March, sometimes broken by a wet spell in December. Daytime temperature is lowest in June and July and highest in January. There is little change in night temperatures throughout the year. Fly rounds were made with two bait cattle and a team of seven. The tsetses caught were marked and released again. The results are given in some detail for the various kinds of vegetation through which the rounds were made.

The following is based on the author's summary. Temperature and saturation deficiency both exerted a generally inverse effect on the activity or apparent density of both *G. pallidipes* and *G. austeni*. True density of *G. pallidipes*, calculated by correcting the apparent density to what it should have been at a saturation deficit of 10 millibars on the assumption that a change of 1 millibar causes a 10 per cent. change in activity, also varied inversely as the saturation deficiency. Exceptional activity that was displayed by both sexes of *G. pallidipes* and *G. austeni* in the morning during periods of severe dry weather is termed rush activity. The theory that rush activity is really compressed activity induced by very high temperature and saturation deficiency on the previous day is supported in a discussion of the reaction of *G. pallidipes* in two adjacent areas with vegetation of different types under normal and abnormal dry-season conditions.

Teneral flies, on which data were kept for *G. pallidipes* only, were taken in remarkably small numbers on all rounds. Females formed a large proportion of the catches of teneral flies. Teneral flies showed no apparent preference for marginal areas; they were more numerous in the wet season. The activity and density of females of *G. pallidipes* appeared to be influenced by the same factors and in the same way as those of the males. Adequate data on *G. austeni* were

obtained from forest only, but there were indications of seasonal fluctuations in female percentage. Females of both species were distributed evenly throughout the vegetation types and no marked vegetational preferences were shown. The females of *G. brevipalpis* formed only a very small proportion of the total catches. The numbers of marked tsetses of all three species recaptured were very small indeed. The majority were recaptured after the lapse of a few days in the locality in which the original markings had been made. *G. pallidipes* was retaken in greater numbers during the humid than during the dry season.

TRAPIDO (H.). **The residual Spraying of Dwellings with DDT in the Control of Malaria Transmission in Panama, with special Reference to *Anopheles albimanus*.**—*Amer. J. trop. Med.* **26** no. 4 pp. 383–415, 13 figs., 2 graphs, 24 refs. Baltimore, Md., 1946.

The results are given of the first 15 months' work in an investigation begun in 1944 on the effectiveness of spraying houses with DDT to leave a residue toxic to Anophelines as a malaria control measure in the middle Chagres River area of Panama, where the chief vector is *Anopheles albimanus*, Wied. Houses with cane walls and palm-thatched roofs in the village of Gatuncillo were sprayed, inside and out, with a 5 per cent. solution of DDT in kerosene at intervals of four months, except for one trial period of six months. Studies of Anopheline populations were made at this village and at two adjacent ones used as controls. All the villages were inaccessible except by boat or foot trail, so the inhabitants seldom left them. Meteorological and living conditions and experimental methods and equipment are described.

The treatment was found to effect a large reduction in the number of Anophelines visiting the dwellings (from 99–178 to 1·8–4·5 per house per night during the three weeks following the first application), to reduce the percentage engorging among those that entered (from 27·4–74·3 in the control villages to 0–16·7 in the treated village for the four months following each treatment) by activating them [*cf. R.A.E.*, B **34** 189]; and to effect a great reduction in the numbers of engorged mosquitos that survived for 24 hours during the three months after spraying. Engorged mosquitos were killed selectively, as a result of their habit of resting for a considerable time close to the place where they have fed and thus having a long period of contact with the treated surface. Four months was shown to be the best interval to leave between treatments, as both the activating effect and the selective killing of engorged females were lost after this. The degree of control improved with each successive treatment. For the four-month period following the third treatment, the malaria transmission potential was reduced by 99·9 per cent., virtually no *Anopheles* being taken in the treated houses for six weeks. Catches in stable traps baited with a horse showed that treatment of houses markedly reduces Anopheline populations in the village area outside the houses, and even to some degree in the forest adjacent to the village (for at least 300 ft.), for several weeks. Evidence is given of reduction of malaria incidence in the village for the 14 months following the first spraying. The cost of the measure and its place in relation to other malaria control procedures and to the economy of the area are discussed.

BATES (M.) & ROCA-GARCÍA (M.). **Experiments with various Colombian Marsupials and Primates in Laboratory Cycles of Yellow Fever.**—*Amer. J. trop. Med.* **26** no. 4 pp. 437–453, 4 figs., 2 diagrs., 27 refs. Baltimore, Md., 1946.

The following is substantially the authors' summary. An account is given of attempts in Colombia to interpose various local marsupials and monkeys in laboratory cycles of yellow fever, in which the vector used was a mosquito

referred to as *Haemagogus capricorni*, Lutz, but stated in a footnote to have been identified by Kumm, Osorno-Mesa & Boshell-Manrique as a form of *H. spegazzinii*, Brèthes [subsp. *falco*, Kumm, Osorno & Boshell (cf. *R.A.E.*, B 37 26)]. Of 11 attempts to infect the mosquitos on the brown masked opossum (*Metachirus nudicaudatus*), only one was successful, though 11 of 13 examples bitten by infected *Haemagogus* showed circulating virus. One out of four woolly opossums (*Caluromys laniger*) showed circulating virus after being bitten by infected *Haemagogus*. These two species are considered to be the most susceptible of Colombian marsupials, and it thus seems doubtful whether any of these can play an important part in the cyclical maintenance of yellow fever by *Haemagogus* in Colombia.

The maintenance of cycles with *Haemagogus* and various monkeys [cf. 36 112] was relatively easy, and constant mosquito-mammal passages were maintained for a year through 14 cycles, using saimiri and douroucoulis monkeys (*Saimiri sciureus caquetensis* and *Aotus trivirgatus*) and the marmoset, *Oedipomidas oedipus*. Attempts to infect the widow monkey (*Callicebus ornatus*) gave irregular results, and the local capuchin (*Cebus fatuellus*) in four instances failed to develop enough circulating virus to infect the mosquitos. It thus seems likely that all monkeys are not equally important in the maintenance of virus cycles in nature. Since the various species of mammals and mosquitos and the various strains of virus show differences in behaviour from place to place, it is considered important that transmission experiments should be made with local material.

WADDELL (M. B.) & TAYLOR (R. M.). **Studies on cyclic Passage of Yellow Fever Virus in South American Mammals and Mosquitoes. II. Marmosets (*Callithrix penicillata* and *Leontocebus chrysomelas*) in Combination with *Aedes aegypti*.**—*Amer. J. trop. Med.* 26 no. 4 pp. 455–463, 2 figs., 7 refs. Baltimore, Md., 1946.

In the course of work on the cyclic passage of yellow-fever virus in South American mammals [cf. *R.A.E.*, B 36 114], experiments were carried out to determine whether a strain of the virus isolated from marmosets (*Callithrix penicillata*) caught in a part of the State of Bahia, Brazil, where jungle yellow fever is apparently endemic in man and transmitted by *Haemagogus spegazzinii*, Brèthes, could be maintained by alternate serial passages through *C. penicillata* or *Leontocebus chrysomelas*, the two commonest monkeys in the region, and a mosquito vector. The experiments are described; the mosquito used was *Aedes aegypti*, L. The passages were initiated by infecting mosquitos on a marmoset (*C. aurita*) that had been inoculated subcutaneously with a suspension of liver from the second-passage *C. penicillata*. The strain was easily maintained in both hosts. Most of the individuals of *C. penicillata* succumbed but all those of *L. chrysomelas* survived.

BONNET (D. D.) & WORCESTER (D. J.). **The Dispersal of *Aedes albopictus* in the Territory of Hawaii.**—*Amer. J. trop. Med.* 26 no. 4 pp. 465–476, 1 fig., 30 refs. Baltimore, Md., 1946.

Literature on the dispersal range of species of *Aedes* is briefly reviewed, and an account is given of experiments in Oahu in which adults of *A. albopictus*, Skuse, were bred, marked and released and then recaptured at various places in the open by using an aspirator that would suck them in on the wing. The experimental area is described. The percentages retaken of the batches released ranged from 0.09 to 33.3, and the percentage of all released mosquitos recaptured was 3.8. The capture on two occasions of large numbers of marked mosquitos some way from the place of release and the observation that

mosquitos at a collecting site often disappeared suddenly were taken as indications that *A. albopictus* may travel in swarms, but further experiments are necessary to establish this. Wind had little responsibility for distribution in the case of this species. The mosquitos flew close to the ground and were never observed flying in a strong breeze. They were seen to drop in flight and cling to vegetation during moderate or heavy gusts of wind. In general, the only effect of wind is to determine direction of flight, for the mosquitos were observed flying into the wind when the velocities were extremely low. The maximum distance at which a recapture was made was 475 yards. The maximum time elapsing between release and recapture was 21 days, the distance covered in this case being 232 yards. Treating the entire series as a whole, the mean time elapsing between release and recapture for the 183 mosquitos recovered was 4.5 days, and the mean distance travelled was 68.7 yards, so that the mean rate of travel was 15.2 yards per day. It is concluded that the distance that adults of *A. albopictus* normally travel during their life is not likely to be more than 200 yards, and that as the distance is determined by a large number of factors, a statistical analysis of the data is of questionable value.

YOUNG (M. D.), ELLIS (J. M.) & STUBBS (T. H.). **Studies on imported Malarías.**

**5. Transmission of foreign *Plasmodium vivax* by *Anopheles quadrimaculatus*.**—*Amer. J. trop. Med.* **26** no. 4 pp. 477–482, 3 refs. Baltimore, Md., 1946.

In this fifth paper of a series [cf. *R.A.E.*, B **37** 93], an account is given of detailed observations in the United States on the ability of *Anopheles quadrimaculatus*, Say, to transmit *Plasmodium vivax* originating from many parts of the world to 186 patients. Of 151 white patients and 35 negroes, 92.1 and 28.6 per cent., respectively, became infected after one attempt and 94.7 and 31.4 per cent. after 1–3 attempts. When the same strains (infections originating from one relapsing case) were tested against both, white patients were more readily infected than negroes in a ratio of 3.6 : 1. All the strains were highly infective to white patients. The negroes seemed to have a general resistance to *P. vivax* from all areas rather than to strains from particular areas only. There was less difference in the transmission rates of strains from the Pacific and those from the Mediterranean areas than between those from different places within each of these areas. In three white patients, a recent self-terminated infection with a local strain of *P. vivax* failed to prevent the development of foreign strains, indicating that the former conferred little or no immunity against the latter. Should this be true of all American strains, the white population of the United States could be considered not to be immune from malaria caused by foreign strains of *P. vivax*.

DAMPF (A.). **Notas sobre flebotómidos mexicanos. II. *Phlebotomus almazani* Galliard 1934 y *P. yucatanensis* Galliard 1934.**—*An. Esc. nac. Cienc. biol.* **4** no. 4 pp. 423–435, 7 pls., 14 refs. Mexico, D.F., 1947. (With a Summary in English.) **III. Un nuevo flebotomo (*P. chiapanensis* n. sp.) aparentemente antropolófilo.**—*Medicina* **27** no. 530 pp. 179–183, 6 figs., 6 refs. Mexico, D.F., 1947.

In the first of these papers, which are parts of a series on the Mexican species [cf. *R.A.E.*, B **34** 88], the author redescribes the types of *Phlebotomus almazani*, Galliard, and *P. yucatanensis*, Galliard, describes the female of *P. vilhelai*, Mangabeira, and states that *P. baduelensis*, Floch & Abonnenc, and *P. rorotaensis*, Floch & Abonnenc, both of which were described from French Guiana in papers already noticed [**34** 56], are synonyms of *P. yucatanensis* and

*P. villelai*, respectively. In the second, he describes *P. chiapanensis*, sp. n., from a female taken in July 1938 while apparently about to attack man at night on a river bank in the State of Chiapas, Mexico.

GÖRNICZ (K.). **Erfahrungen bei der Rapsglanzkäfer- und Fliegenbekämpfung mit Gesarol.** [Experience in the Control of *Meligethes aeneus* and Flies with Gesarol.]—*Festschr. Appel 1947* pp. 41–44, 3 refs. Berlin-Dahlem, Biol. ZentAnst. Land- u. Forstw., 1947.

This paper, part of which is noticed elsewhere [*R.A.E.*, A 37 405] contains an account of experiments in Prussian Saxony in 1944 and 1945 in which sprays containing various proprietary preparations of DDT were successfully applied to surfaces in houses and animal quarters to leave a deposit toxic to flies (*Musca domestica*, L. and *Stomoxys calcitrans*, L.). Good control was obtained in living rooms by treating the walls with a distemper containing 5 per cent. DDT and only a small proportion of binding agent, so that the deposit adhered to the flies that alighted on it. In one room, the distemper was still giving protection after a year.

WIESMANN (R.). **Untersuchungen über das physiologische Verhalten von *Musca domestica* L. verschiedener Provenienzen.** [Investigations on the physiological Reaction of *M. domestica* of different Origins.]—*Mitt. schweiz. ent. Ges.* 20 pt. 5 pp. 484–504, 3 figs., 3 refs. Berne, 1947.

Following a report in 1946 that house-flies (*Musca domestica*, L.) in northern Sweden, particularly at Arnäs (some 600 miles north of Stockholm), were not controlled in cattle sheds sprayed with 0.1 per cent. DDT as 1 per cent. Gesarol M, a culture of the flies from Arnäs was established at Basle and compared with the local strain in tests with p,p' DDT. In the first of these, the flies were confined in petri dishes of which the bottom and lid had both been covered with 1 cc. of an acetone solution of 1 per cent. DDT, so that a fine deposit of 10 mg. DDT resulted. The periods required for knockdown were 13–18 minutes for the Basle flies and 54–143 minutes for the Arnäs flies, the averages being 16 and 93 minutes. When the flies were transferred to fresh dishes after various periods of contact with the deposit, contact for 2–3 seconds caused knockdown of the Basle flies in 50–60 minutes and there were no recoveries, whereas mortality of the Arnäs flies approached 100 per cent. only after contact for at least 25 minutes. Contact for 3 minutes caused some temporary loss of mobility, 10 per cent. were severely affected after contact for 6 minutes but recovered in 24 hours, and though all became incapacitated after contact for 20 minutes, only 32 per cent. did not recover. Of two groups of 30 flies of the Arnäs strain exposed for 75 and 90 minutes, respectively, two in each recovered after exhibiting symptoms of extreme poisoning, which indicated a highly developed individual reaction to DDT.

When the deposit of DDT in the dishes was reduced progressively from 10 to 0.01 mg., the average periods of contact required for knockdown increased from 15 to 40 minutes for the Basle flies and from 90 to 370 minutes for the Arnäs flies. When the deposit was reduced to 0.001 mg., the Arnäs flies showed no reaction in 24 hours, while the Basle flies were knocked down in an average of 370 minutes. Differences in susceptibility between the strains were also demonstrated when the head, thorax, wings, abdomen, coxae or tarsi of flies were dabbled with 1 per cent. DDT in acetone and the times required for knockdown without recovery compared. These times were 18, 10, 17,

10, 3 and 4 minutes for the Basle flies and 460, 197, 160, 130, 21 and 102 minutes for the Arnäs flies. The difference between the strains was thus least for the coxae, which appear to be readily penetrated by DDT, and greatest for the head. One of the Arnäs flies treated on the head recovered after temporary knockdown. The dosage of DDT absorbed through the tarsi and producing 50 per cent. knockdown in 24 hours without recovery (determined by confining fed flies 5-6 days old singly on glass plates bearing various deposits in such a way that the fly picked up the whole of the deposit) was found to be 0.025 $\gamma$  for the Basle strain and 2.5-5 $\gamma$  for the Arnäs one. When the tarsi of normal amputated legs were dabbed with DDT, a strong tremor that lasted for hours was produced in the Basle strain, but no reaction, or a tremor at the tips of the tarsi only, in the Arnäs one.

In further tests on physiological reactions, the flies were exposed to heat, cold and narcosis. The periods of exposure required to produce heat torpor at 45, 50 and 55°C. [113, 122 and 131°F.] were 34, 20 and 10 minutes for the Basle flies and 46, 30 and 10 for the Arnäs flies, while exposure at 55°C. until heat torpor occurred caused 100 per cent. mortality in the former and only 57 per cent. in the latter. At 12°C. [53.6°F.], only 18 per cent. of the Arnäs flies became torpid in 3 hours, whereas all the Basle flies became so in 42 minutes. The latter were more rapidly affected by methyl acetate, but recovered from it in half the time required by the former.

The Arnäs flies were found to differ morphologically from the Basle flies in that the legs were much more pigmented, the tarsal bristles much stiffer, the differences in the size of the tarsal joints less pronounced, the tarsal joints broader, and the cuticle of the pads and of the articular membranes of the tarsal joints about one-third thicker. The existence of morphological as well as physiological differences suggests that the two strains should be considered races. The differences in resistance to DDT are apparently due to the differences in the tarsi.

LUDWIG (R. G.) & NICHOLSON (H. P.). **The Control of Rat Ectoparasites with DDT.**—*Publ. Hlth Rep.* **62** no. 3 pp. 77-84, 3 pls., 2 figs., 1 ref. Washington, D.C., 1947.

Field studies to determine what control of ectoparasites of rats could be effected by treating rat-infested premises with a dust containing 10 per cent. DDT were made in Savannah, Georgia, from May to November 1945. Rats were trapped in 11 heavily infested business premises before treatment, one week following treatment, and about once a month thereafter. Rats were also trapped in 46 similar untreated premises to determine seasonal fluctuations in the numbers of their ectoparasites, but only *Xenopsylla cheopis*, Roths., was sufficiently numerous and uniformly distributed to allow of an analysis. Almost all the rats taken were *Mus (Rattus) norvegicus*. Methods of trapping rats, collecting and identifying ectoparasites and applying treatment, and the equipment used for treatment, are described. The equipment consisted of foot-pump dusters, with which the DDT dust was blown into burrows and enclosed harbourages, and hand shaker dusters with which a light layer was sifted along rat runways. Spectacular and consistent control of *X. cheopis* was effected in all treated buildings. Control at the first inspection was 99.3 per cent. At the next four monthly inspections, it fell off at the rate of about 5 per cent. per month. A certain control of rat mites (*Liponyssus bacoti*, Hirst, *Laelaps hawaiiensis*, Ewing, *Echinolaelaps echidninus*, Berl., and *Uropoda* sp.) and rat lice (*Polyplax spinulosa*, Burm.) was achieved, but data were insufficient to justify the statement of a definite percentage.

TARZWELL (C. M.) & FISK (F. W.). **Observations on the nighttime Resting and Biting Habits of Anopheline Mosquitoes in DDT-treated and -untreated Buildings.**—*Publ. Hlth Rep.* 62 no. 3 pp. 84–94, 2 figs., 1 ref. Washington, D.C., 1947.

The behaviour of female Anophelines in houses that they enter in search of food is of importance in relation to their control with DDT deposits, as the acquisition of a lethal dose depends on the length of time that they rest on a treated surface. Observations on the night-time behaviour and resting habits of females of *Anopheles quadrimaculatus*, Say, were carried out in Georgia in a specially prepared cow barn with a cow as bait in September 1944 and a specially prepared room with a goat and three observers as bait in September 1945. Windows and doors were left open for the mosquitos to enter or leave at will. The night was divided into observation periods ranging from 15 minutes to more than an hour. The position of every mosquito observed during the studies was plotted on a chart, the period during which it was first and last seen being noted. Two all-night observations were carried out in the cow barn in early September before treatment and a third in late September after it had been sprayed with DDT at 200 mg. per sq. ft. The main study of the test room was made on one night four months after it had been treated with DDT at 117 mg. per sq. ft. In addition, five overnight studies of biting habits and knockdown were made in the same room, three months after spraying by an investigator who spent the night on a bed without a net, so that mosquitos entering could feed on him at will. Two similar studies were made with a cow as bait in a barn sprayed 11 months earlier.

The average resting periods of engorged and unengorged females in the untreated barn were similar (170 and 167 minutes). The resting period of individuals varied from a few minutes to over 10 hours. The observed resting period in the barn after treatment was much shorter than before treatment, possibly owing to the irritating effect of the DDT deposit. The range was from a few to 90 minutes, and the averages for engorged and unengorged females were 33 and 40 minutes, the difference not being significant. It is concluded that a large proportion of mosquitos entering a treated building will rest on the treated surfaces long enough to obtain a lethal dose. The percentage engorged among females resting on the walls increased from 14 before treatment to 31 after it, perhaps indicating that many of the unengorged ones that entered after treatment were irritated by the DDT and left before attempting to bite. Immediately after spraying, irritation is produced so rapidly that considerable protection against biting is afforded. Many females entered the barn at dusk, both before and after treatment. Before treatment, the number resting increased throughout the night, reaching a maximum about an hour before daylight, whereas after treatment, the largest number was present just after the influx at dusk and only a few were there at any time during the rest of the night. Observations in the treated room were similar. The mosquitos remained only a short time after the rapid influx at dusk, and the maximum resting period appeared to be less than 15 minutes. Of the females observed, 23 per cent. were engorged.

In the first three biting and knockdown studies, an exit trap was placed in one window, the others were screened an hour before dawn, and 223 female mosquitos, of which 81 were Anophelines, were taken. All mosquitos were down on the floor or in the trap except one (unengorged) in the room and 15 (two engorged) in the trap, and only 16 of the mosquitos down were engorged, indicating considerable protection against biting. In the last two studies, all windows were left open. Only about half the mosquitos found at 9 a.m. had been knocked down, probably because they had entered too recently to be affected. Of the active and moribund females of *A. quadrimaculatus*, 41 per

cent. were sufficiently engorged to permit a precipitin test to be made. This showed human, equine and bovine blood, the last greatly predominating. It is concluded that many females entered to rest rather than feed. Many mosquitos were knocked down in the barn sprayed 11 months previously. Most of them were engorged, practically all on bovine blood.

MATHIS (W. V.), FERGUSON (F. F.) & SIMMONS (S. W.). **Comparative Studies of DDT Dusts, DDT-Oil Sprays, and Paris-green Dusts used routinely in Anopheline Larvae Control.**—*Publ. Hlth Rep.* **62** no. 3 pp. 95-102, 2 refs. Washington, D.C., 1947.

In the large-scale comparative studies described, which were carried out over 41 sq. miles in Georgia between 1st March and 19th October 1945, DDT at 0.1 lb. per acre was shown to be satisfactory and to compare favourably with a 10 per cent. paris-green dust applied at 10 lb. per acre for routine control of Anopheline larvae. The DDT was used as a 1 per cent. dust applied at 10 lb. per acre, as an emulsified oil solution at 15 U.S. gals. total emulsion per acre, or as an unemulsified oil solution at 1 U.S. gal. per acre dispersed by light-weight air-pressure sprayer as an air-borne mist. All treatments gave good initial control as assessed by dipping 24 hours after treatment. The DDT dust gave about the same control of large larvae as the paris green and somewhat better control of small larvae. Both the emulsion and the mist gave better control of all instars than did either dust. Counts after one week indicated that there was no lasting effect from any treatment. Assessed by the numbers of adults in natural resting places within a quarter of a mile of treated sites, control was satisfactory in all areas.

The mist took less time to apply than the dusts, its use effecting estimated savings in man-hours of 36 and 52 per cent. when the areas treated were up to and more than 10 ft. wide, respectively. The emulsion took longer to apply than any other formula. Routine application of DDT in oil at 0.1 lb. per acre caused considerable damage to fish. It has been found that 0.05 lb. DDT gives comparable larval control, apparently without causing appreciable damage to wildlife.

CABASSO (V.). **Reaction of the Human Body Louse : (*Pediculus humanus corporis*) to the Ingestion of Guinea Pig Blood.**—*Proc. Soc. exp. Biol. Med.* **64** no. 4 pp. 437-439, 4 refs. New York, N.Y., 1947.

Man is apparently the only natural host of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.), and more unsuccessful than successful attempts to feed the lice on other hosts, such as rodents and birds, have been recorded. It is therefore often assumed that the blood of certain animals, particularly rodents, is toxic to *Pediculus* [cf. *R.A.E.*, B **24** 119; **34** 1]. An account is given of studies made in Tunis on the effect of guineapig blood on *P. h. humanus*.

The first experiment, in which starved female lice that engorged on man or on the shaven and cleaned flank of a guineapig were kept at 30-32°C. [86-89.6°F.] and dissected at intervals and the gut contents compared, showed that the human blood was digested in four hours, but the red blood cells of the guineapig remained undigested until the lice died, generally about 48 hours after the meal. Many lice showed signs of rupture or radically altered permeability of the intestines. In a second experiment at the same temperature, lice of both sexes that had been starved for an average of 36 hours and were then allowed to feed once on a guineapig died within 72 hours, apparently of starvation. Control lice fed on man died 96-120 hours after their last meal. The third experiment was made with lice that had engorged on a guineapig, on which they were kept

for an hour, and were then kept in an incubator at 37°C. [98.6°F.] for two hours to induce rapid dehydration and reduction of the blood meal. They were allowed to feed on man on withdrawal from the incubator and subsequently twice daily and lived their normal life span. It is concluded that guineapig blood is not toxic to the lice, but that they cannot digest it.

CABASSO (V.). **Mass Infection of Body Lice with *Rickettsia prowazeki*.**—*Proc. Soc. exp. Biol. Med.* **64** no. 4 pp. 439–440, 2 refs. New York, N.Y., 1947.

The finding that guineapig blood is not toxic to *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) [see preceding abstract], made it possible to infect lice with *Rickettsia prowazeki* on a large scale. Female lice 12–13 days old were starved for 30 hours, allowed to engorge on the prepared flank of a guineapig infected ten days previously with the Tunis strain of classical typhus, kept in the incubator for two hours at 37°C. [98.6°F.] and then maintained by feeding twice daily on a typhus-immune man. After eight days, 37 out of 50 were still alive. Some of the survivors were dissected, and microscopical examination of the intestines revealed the presence of large numbers of rickettsiae in all of them. Infection with *R. prowazeki* was subsequently proved by the results of injection of suspensions of excreta, collected 8–10 days after the infective meal, and of intestines and intact lice, into guineapigs. Guineapigs can be easily infected and maintained in the laboratory, and their use in infecting lice would be much more convenient than rectal injection for preparing typhus vaccine [cf. also *R.A.E.*, B **32** 219].

#### PAPERS NOTICED BY TITLE ONLY.

DUBOIS (K. P.) & MANGUN (G. H.). **Effect of Hexaethyl Tetrphosphate on Choline Esterase *in vitro* and *in vivo*.**—*Proc. Soc. exp. Biol. Med.* **64** no. 2 pp. 137–139, 1 fig., 1 ref. New York, N.Y., 1947. [See *R.A.E.*, A **37** 440.]

LORD (K. A.). **The Contact Toxicity of a Number of D.D.T. Analogues and of four Isomers of Benzene Hexachloride to *Macrosiphoniella* [*Macrosiphum*] *sanborni* and *Oryzaephilus surinamensis*.**—*Ann. appl. Biol.* **35** no. 4 pp. 505–526, 7 figs., 40 refs. London, 1948. [See *R.A.E.*, A **37** 411.]

STRINGER (A.). **Relation between Bioassay Systems and the Values found for Toxicity of D.D.T.**—*Ann. appl. Biol.* **35** no. 4 pp. 527–531, 4 refs. London, 1948. [See *R.A.E.*, A **37** 412.]

PRADHAN (S.). **Studies on the Toxicity of Insecticide Films. I. Preliminary Investigations [with DDT and  $\gamma$  benzene hexachloride] on Concentration-Time-Mortality Relation.**—*Bull. ent. Res.* **40** pt. 1 pp. 1–25, 1 pl., 12 figs., 27 refs. London, 1949. **II. Effect of Temperature on the Toxicity of DDT Films.**—*T.c.* pt. 2 pp. 239–265, 2 pls., 11 figs., 39 refs. [See *R.A.E.*, A **37** 326, 408.]

METCALF (R. L.). **Some insecticidal Properties of Fluorine Analogues of DDT.**—*J. econ. Ent.* **41** no. 3 pp. 416–421, 15 refs. Menasha, Wis., 1948. [See *R.A.E.*, A **37** 425.]

MINER (F. D.). **A Carbon Tetrachloride Killing Bottle.**—*J. econ. Ent.* **41** no. 3 pp. 506–507. Menasha, Wis., 1948.

BATTE (E. G.). **A Technique for mounting Ectoparasites [lice and ticks].**—*J. econ. Ent.* **41** no. 3 pp. 523–524, 2 figs., 3 refs. Menasha, Wis., 1948.

PRATT JR. (J. J.), HETERICK (R. H.), HARRISON (J. B.) & HABER (L.). **Tires as a Factor in the Transportation of Mosquitoes by Ships.**—*Milit. Surg.* **99** no. 6 pp. 785-788, 8 refs. Washington, D.C., 1946.

Living mosquitos were observed in one of the holds of a cargo ship from the New Guinea area during routine inspection on arrival at Los Angeles in June 1945, and members of the crew had been annoyed by mosquitos for 5-6 days after leaving port. Further investigation showed that about half of the 8,880 motor and aircraft tyres that constituted much of the cargo contained fresh water and many of them contained 20-30 living mosquito larvae. *Aedes scutellaris*, Wlk. (*hebrideus*, Edw.) and *Armigeres milnensis*, Lee, were recovered from practically all the tyres in which larvae were found, and *Culex papuensis*, Tayl., and a species of *Tripteroides* near *quasiornata*, Tayl., were present in smaller numbers. Two larvae and one dead adult of *Megarhinus* sp., and one dead female of *C. annulirostris*, Skuse, were also recovered. Before the ship docked, each hold was closed and treated with a pyrethrum aerosol. Many dead adult mosquitos were subsequently recovered. As the tyres were unloaded, those containing water were sprayed with 5 per cent. DDT in kerosene, and the walls, ceilings and floors of the railway wagons to which they were to be transferred were also sprayed to kill any adults that might emerge in transit. Three wagons were inadvertently loaded before spraying had begun. A pyrethrum aerosol was released into each, and they were immediately sealed. They were again treated with aerosol on arrival at their destination five days later. When they were opened, living larvae were found in large numbers in many of the untreated tyres.

Ten more shipments of tyres were inspected between 9th July 1945 and 4th February 1946. Tyres in eight of them contained water, and mosquitos, including *Aedes albopictus*, Skuse, *A. scutellaris*, *Armigeres milnensis* and *C. papuensis*, were breeding in three shipments. Fresh water was also found in amphibious vehicles, but no larvae or pupae. All the water was treated with 5 per cent. DDT in kerosene. The bionomics of the species found, their importance to man, and the effect on them of conditions on the journey and the climate at Los Angeles are briefly discussed; in view of the large number of larvae that can be imported in one shipload of tyres, strict precautions should be taken to prevent the introduction of exotic mosquitos into the United States.

BRISCOE (M. S.). **Insect Reconnaissance in Liberia, West Africa.**—*Psyche* **54** no. 4 pp. 246-255. Cambridge, Mass. [1948.]

A list with locality records is given of insects collected in Liberia during a survey carried out throughout the year. The blood-sucking Diptera include *Glossina fusca*, Wlk., *G. nigrofusca*, Newst., *G. palpalis*, R.-D., nine Tabanids and 21 mosquitos. The species of *Anopheles* are *A. funestus*, Giles, *A. gambiae*, Giles, *A. hancocki*, Edw., *A. nili*, Theo., and *A. paludis*, Theo. *A. paludis* and four of the Tabanids are new records for Liberia.

MOISER (B.). **Leprosy : a new Outlook.**—*E. Afr. med. J.* **23** no. 10 pp. 295-300. Nairobi, 1946.

In the light of 34 years' experience of leprosy in Nigeria and Southern Rhodesia, including 17 years as a full-time leprologist, the author discusses the disease, its transmission and treatment. He points out that it is rural, not urban, and that there is no proof of direct transmission from man to man, although various occupants of one house are often affected. None of his European patients and

less than 40 per cent. of the African ones had had contact with a previous case. There is no evidence that segregation furthers eradication and the method of transmission is unknown.

The author has investigated the possibility of transmission by cockroaches. At a leprosy hospital in Southern Rhodesia, it was established that cockroaches bit man voraciously at night, producing large wounds and scars that were repeatedly found to contain leprosy bacilli. Cockroaches ingested the bacilli in great numbers when fed on positive material taken from patients, and the bacilli were found in the gut up to 19 days after feeding. They were sometimes so numerous as to suggest multiplication in the cockroach, and were found unchanged in the dried droppings for periods up to 16 months. Of the cockroaches caught in the thatched huts of patients in the locality, 23 per cent. contained leprosy bacilli. Five cases are recorded of the presence of acid-fast bacilli, indistinguishable from the leprosy bacillus in cockroaches caught in native huts several miles from the hospital, in kraals where no case of leprosy had occurred. In one kraal in Gutu Province from which 9 cases had been admitted at various times, the last on 5th August 1940, acid-fast bacilli were found in a cockroach caught on 18th September 1945. Bacilli were found in the faeces of a series of five cockroaches, each fed on the powdered faeces of its predecessor. The author believes that the faeces of infected cockroaches are the source of infection, but as no susceptible laboratory animal is known, this could be proved only by experiments on man.

In about 70 per cent. of all cockroaches examined over a period of years, there were found small acid-fast oval bodies, generally a little larger than a red blood corpuscle but varying in size, that appeared to contain acid-fast rods. It is thought that they may be a stage in the development of the leprosy bacillus. Occasionally these oval bodies were found ruptured, allowing of the escape of the contents, rods or amorphous material. They were observed in man, but not in fleas, bed-bugs or ticks.

YOUNG (W. A.), FARR (A. G.) & MCKENDRICK (A. J.). **Relapsing Fever in the Lake Province of Tanganyika, with an Account of a Case in an eight day old Infant.**—*E. Afr. med. J.* **23** no. 11 pp. 345-347. Nairobi, 1946.

The history of tick-borne relapsing fever in Tanganyika since 1918 is reviewed, with particular reference to Lake Province. The number of cases increased considerably during the war, and the authors knew of nearly 3,000 in the Province in 1945. Dilapidation of buildings made conditions favourable for the vector, *Ornithodoros moubata*, Murr., and the unprecedented movement of Africans in 1942-45 may have contributed even more to the spread of the tick.

The occurrence is also recorded of a case of relapsing fever in a young baby in circumstances that made infection from a tick seem improbable. The mother was admitted to hospital in March 1945 and gave birth to a healthy baby the same afternoon. She had changed to hospital clothes and is said to have bathed upon admission. Eight days later, the baby developed fever, and repeated examination of its blood revealed heavy infection with *Spirochaeta (Treponema) duttoni*, while the mother's blood was consistently negative. The father's blood was also negative, and he said that neither he nor his wife had had fever, but they had slept in a tick-infested house on their way to hospital. Careful search of the maternity block failed to reveal the presence of *O. moubata*, and it was improbable that the tick could find harbourage there. Two bed-bugs [*Cimex*] were found when the cot in which the child lay in a separate room was dismantled, and others in the maternity ward. They were negative when examined at Dar-es-Salaam, but they arrived there in such a dry condition that the validity of the result is doubtful. It is thought that the

bed-bug, which is even commoner than *O. moubata* in Lake Province, may be a vector of the disease.

MOULTON (F. R.). Ed. **Rickettsial Diseases of Man. A Symposium on the Rickettsial Diseases of Man, organized by the Section on Medical Sciences of the A.A.A.S. and presented at the Boston Meeting on December 26-28, 1946.**— $10\frac{1}{4} \times 7\frac{1}{2}$  ins. [7+] 247 pp., illus., refs. Washington, D.C., Amer. Ass. Advanc. Sci., 1948. Price \$6.25 (\$5.25 to members).

This work comprises a series of 27 papers in which a record is given of achievements in the control of rickettsial diseases of man during the second world war, together with a review of the scientific foundations on which the methods adopted rest. Some are concerned with the biology, classification, isolation and identification of the rickettsiae, the pathology, symptomatology and treatment of the diseases in man caused by them, serological reactions and vaccines. The others include **Outbreaks of Q Fever during World War II**, by J. H. DINGLE (pp. 47-50, 31 refs.) [cf. *R.A.E.*, B 37 194]; **Vectors of Rickettsial Diseases**, by G. M. KOHLS (pp. 83-96, 4 pp. refs.), in which a summary is given of published information on the part played by Arthropods in the transmission of rickettsial diseases of man; **The Reservoirs of Infection in Rickettsial Diseases of Man**, by C. B. PHILIP (pp. 97-112,  $3\frac{1}{2}$  pp. refs.), in which possible mammalian reservoirs are discussed, the term animal reservoir being qualified so as not to imply that these animals are the only or even the most important reservoirs of a given disease; **Rickettsialpox—general Considerations of a newly recognized Rickettsial Disease**, by R. J. HUEBNER (pp. 113-117, 9 refs.) [cf. 37 165]; and **DDT and other Insecticides for the Control of Lice and Fleas attacking Man**, by E. F. KNIPLING (pp. 215-223, 24 refs.), most of the information in which has been noticed from numerous individual papers. Brief abstracts of the remaining papers are given below.

BAYNE-JONES (S.). **Epidemic Typhus in the Mediterranean Area during World War II with special Reference to the Control of the Epidemic in Naples in the Winter of 1943-1944** (pp. 1-15, 2 figs., 34 refs.). Outbreaks of louse-borne typhus in Persia, Egypt, Algeria, Morocco and Italy (Naples) in 1943-45 are discussed in relation to the development and application of modern methods of prevention and control, particularly the control of *Pediculus humanus*, L., at first with a pyrethrum preparation, MYL [34 45], and later with DDT dust applied by hand and power dusters to fully clothed people [36 180, etc.].

GORDON (J. E.). **Louse-borne Typhus Fever in the European Theater of Operations, U.S. Army, 1945** (pp. 16-27, 2 figs.). This is essentially a review of the typhus hazard to which the United States Army was exposed in Europe from the time of arrival at bases in Great Britain, together with a discussion of its programme for typhus control in Europe. In the latter, great reliance was placed on the control of lice on patients, contacts and at times large sections of the general population by means of DDT powder. Louse-borne typhus had become established in Germany in 1939 and increased as the war proceeded through importation of infection from the east, until there were over 16,000 cases in 1945 in the zone occupied by the U.S. forces. In Great Britain, no measures were necessary except the delousing of German prisoners, who began to arrive after June 1944. Certain groups of civilians in France, Belgium, Luxemburg and the U.S. sector of Holland were treated to free them from lice, though no cases of typhus occurred in those countries between the beginning of operations in June 1944 and the end of the year. During this period, the chief danger of spreading the disease was through prisoners of war. The first problem in the control of outbreaks was an epidemic in the Rhineland, where two major centres of infection were encountered early in 1945. This

was soon brought to an end, but later in the year, epidemic conditions were found to prevail in the Inner Reich, largely in concentration camps and among released conscript labourers and German prisoners of war and returning German refugees. This outbreak was controlled by July. An account is given of some of the problems unsolved and of the extent to which the disease spread into neighbouring countries; only three confirmed cases occurred in the U.S. Army.

SCOVILLE JR. (A. B.). **Epidemic Typhus Fever in Japan and Korea** (pp. 28-35, 7 figs.). Louse-borne typhus was epidemic and very widespread in Japan, and Korea during 1945-46 when over 30,000 cases were reported. Details are given of predisposing conditions, the course of the epidemic and the effective control measures taken by the tactical and military government forces and the United States Typhus Commission among the troops, repatriated persons and Japanese and Korean civilians. They included extensive use of DDT powder and monthly applications of DDT sprays to leave a toxic residue in billets and trains used by American troops.

MAXCY (K. F.). **Scrub Typhus (Tsutsugamushi Disease) in the U.S. Army during World War II** (pp. 36-46, 3 maps, 23 refs.). The status of tsutsugamushi disease in south-eastern Asia and the south-west Pacific at the beginning of the war in that region is reviewed, and accounts are given of Allied Forces' experience of the disease in Australia, New Guinea and adjacent islands, the Philippines, Ceylon, Assam and Burma, and of field and laboratory studies on its etiology, Trombiculid vectors, animal reservoirs and distribution.

GREELEY (D. M.). **Methods of Application of DDT** (pp. 224-228, 24 refs.). The various ways in which DDT is used for the control of Arthropods that transmit rickettsial diseases to man are described. The chief one is the application of 10 per cent. dusts with hand or power dusters to clothing and the hair of the head and other parts of the body for the control of head and body lice [*Pediculus humanus humanus*, L., and *P. h. capitis*, Deg.] and fleas. If dusters are not available, spoons may be used. Application should be thorough, and routine procedure to assure this when treating fully clothed people is suggested. Methods of impregnating clothing with DDT are also given. *Xenopsylla cheopis*, Roths., the vector of murine typhus, can be killed by dusting the rat hosts, and methods of applying DDT to rat runs and holes to achieve this are noticed. To control the ticks that transmit Rocky Mountain spotted fever and Q fever, DDT has been used with success for treating infested ground and vegetation as a spray, a powder or a thermally generated aerosol. Cats and dogs should not be treated with solutions or emulsified solutions of DDT for the control of ticks, but they may be dusted with the 10 per cent. DDT powder. DDT is not effective against the Trombiculids that transmit tsutsugamushi disease.

BRADLEY (G. H.) & WILEY (J. S.). **The Control of Murine Typhus in the United States** (pp. 229-240, 3 figs., 20 refs.). The distribution and importance of murine typhus in man in the United States are discussed. The number of cases increased from 300 in 1930 to 5,353 in 1944. In 1945, a programme of measures including rat control and control of ectoparasites of rats (principally *Xenopsylla cheopis*, Roths.) by fumigation and dusting of rat runs and harbours with DDT was introduced, and although the incidence of the disease decreased throughout the endemic area in the South, the decrease in the 124 treated counties was twice as great as elsewhere and the difference was attributed to the action taken.

BUSHLAND (R. C.). **Miticides and Mite Control** (pp. 241-247, 11 refs.). This is a review of the development of measures against the Trombiculid mites that transmit tsutsugamushi disease directed against them when they are on the clothing or in their natural environment. The research is traced from the basic studies initiated in the United States through field tests in the Pacific

war zone to practical use by troops in infected areas. The chief measure is the impregnation of clothing with compounds lethal to the mites. A secondary approach is the clearing of the breeding areas of the mites to expose them to the action of the sun and spraying or dusting of the infested soil with suitable organic compounds.

ANDREW (R.), BONNIN (J. M.) & WILLIAMS (S.). **Tick Typhus in North Queensland.**—*Med. J. Aust.* August 24, 1946, pp. 253–258, 2 figs., 9 refs. Sydney, 1946.

FUNDER (J. F.) & JACKSON (A. V.). **North Queensland Tick Typhus: a comparative Study of the Rickettsia with that of Murine Typhus.**—*T.c.* pp. 258–263, 1 fig., 8 refs.

PLOTZ (H.), SMADEL (J. E.), BENNETT (B. L.), REAGAN (R. L.) & SNYDER (M. J.). **North Queensland Tick Typhus: Studies of the aetiological Agent and its Relation to other rickettsial Diseases.**—*T.c.* pp. 263–268, 23 refs.

In the first paper, details are given of the epidemiology and clinical and laboratory features of a disease of which 12 cases occurred among servicemen on the Atherton Tableland in northern Queensland between March 1944 and February 1945 and to which the name North Queensland tick typhus is tentatively applied. There was evidence that the incubation period was about 7–10 days, though these figures probably do not represent the extreme range. An eschar developed in nine cases. The disease was mild, lasting about a week, and the symptoms included enlarged glands, headache, fever and rash. The Weil-Felix test produced agglutination with *Proteus* OX19 and sometimes OX2 but not OXK. A *Rickettsia* was isolated from two patients by intra-peritoneal inoculation of freshly drawn blood on the sixth day of disease into mice, and transmitted to guineapigs by inoculation of mouse spleen tissue and peritoneal scrapings. Both strains became firmly established in guineapigs, and the animals showed a scrotal reaction. Agglutination and complement-fixation tests in the United States failed to show any serological relation with epidemic or murine typhus, Marseilles fever, South African tick bite fever or Rocky Mountain spotted fever. The differential diagnosis of North Queensland tick typhus, tsutsugamushi disease (scrub typhus), murine typhus and certain other diseases is discussed.

The climate and vegetation of the Atherton Tableland are described. Much of it is dense rain forest with abundant rodents and marsupials infested by ticks and mites. The ticks include four species that bite man (*Ixodes holocyclus*, Neum., *Haemaphysalis bancrofti*, Warb. & Nutt., *Boophilus annulatus microplus*, Can., and *Rhipicephalus sanguineus*, Latr.). Of the 12 men who developed the disease, seven were known to have been bitten by ticks in the preceding two weeks. Eschars developed in two cases at the site of the bite, and in a third at the site of biting by what is thought might have been a larval tick. A larva of *I. holocyclus* was found engorged in the axilla on a fourth patient, and in this case there was an eschar about four inches from the tick. Ten of the cases occurred in August and September, during the spring rains, when *I. holocyclus* is most abundant. This is the most plentiful of the four species, the most attracted to man and the only one that was found on the troops.

The other papers concern comparative studies of the two strains of *Rickettsia* isolated in Queensland and the agents of other diseases of the typhus and spotted fever groups. It is shown that in addition to the diseases enumerated in the first paper, North Queensland tick typhus is also serologically distinct from Q fever. The disease induced in mice and guineapigs was different from that ordinarily resulting from infection with tsutsugamushi disease, and mice convalescent from infection with a strain of North Queensland tick typhus were fully susceptible to inoculation with the latter. Guineapigs recently convalescent

from North Queensland tick typhus, South African tick bite fever or murine typhus were solidly immune from reinfection with the homologous agent and displayed considerable resistance to infection with the heterologous strains. The question is raised whether this resistance to heterologous agents is evidence of specific immunity or of acquired cellular resistance dependent on other factors.

HEILIG (R.). **Typhus in Rajputana.**—*Indian med. Gaz.* **81** no. 10 pp. 399–400, 7 refs. Calcutta, 1946.

Several hundred cases of tropical (non-epidemic) typhus have been described from various parts of India [*R.A.E.*, B **26** 56–57, 198–199, etc.] but none from Rajputana, and inquiry among local physicians as to the occurrence of unpublished cases elicited only one positive reply concerning a patient at Bikaner Hospital in 1945. In view of the evident rarity of the disease in Rajputana, a description is given of a case that was seen in March 1946. The patient had not left Jaipur for many months. His serum agglutinated Proteus OX19 at a dilution of 1 : 250 and Proteus OX2 at 1 : 50 but not OXK at 1 : 50. These reactions indicated that the vector was a rat-flea or a tick, probably the former; mites were excluded because of the lack of agglutination of OXK, and lice because of the clinical course of the disease, the cleanliness of the patient and his family and the almost complete absence of agglutination of OX2 in louse typhus. Several ticks were collected from cows kept by the patient, and a ground suspension of four of them was injected into two guineapigs and four mice, but no evidence of infection was obtained. The patient stated that there were rats in his home, but as attempts to trap them failed, the possibility of transmission by rat-fleas could not be investigated.

CHIT THOUNG (U.). **Poisonous Effects of D.D.T. on Humans.**—*Indian med. Gaz.* **81** no. 10 p. 432. Calcutta, 1946.

Illness, with diarrhoea, vomiting, slow pulse, giddiness and dilated pupils, occurred among 72 members of a unit of Frontier Force Constabulary in Burma in July 1946, after they had eaten rice. Of two samples of the rice examined, one was found to contain about 16 per cent. DDT, while the other contained none.

BATEMAN (E. W.) & HEATH (G. D.). **The Generation of insecticidal Smokes.**—*J. Soc. chem. Ind.* **66** no. 9 pp. 325–330, 1 fig., 1 ref. London, 1947.

Insecticidal smoke generators that could be dropped from aircraft flying over jungle canopy to control Anopheline mosquitos were devised during the recent war, and although they were not used in actual operations, subsequent field trials demonstrated their feasibility. The generation of smoke clouds by sublimation is impracticable in the case of DDT, owing to its thermal instability; BHC (benzene hexachloride) is more stable. A method of volatilisation using an intimate mixture of the insecticide with a vaporiser was considered to be the most suitable, and this paper consists mainly of an account of the work performed to determine the most satisfactory pyrotechnic mixture for the purpose. The generator employed was of a type already in use for the production of coloured smokes. It comprises a perforated tinned plate receptacle containing the mixture within an outer tinned plate body into which the smoke passes, and from which it issues through four holes at the top. For use from aircraft, the generator had a percussion fuse that caused ignition on striking the ground, but for use on the ground, it is ignited by releasing a spring-actuated hammer that strikes a percussion cap from which a safety-fuse leads to a shallow disk primed with an igniter composition, which ignites the smoke mixture. A simpler

type of generator would be cheaper, but, with the mixture used, some form of cooling baffle is required to prevent the smoke from igniting on issuing from the generator. The chemical efficiency of the smokes and generators was tested by collecting the smoke emitted in wash-bottles containing benzene, from which the insecticide was later extracted and estimated. The reliability of the method was demonstrated by using it to test three generators filled from the same batch of composition.

Since vaporisers based on the combustion of a fuel, such as sucrose or lactose, with oxygen provided by potassium chlorate are the most satisfactory, tests were made to determine the most suitable proportions in which to mix these with DDT. The best results were given by a mixture of 19 per cent. potassium chlorate, 23 per cent. sucrose, and 58 per cent. recrystallised DDT (almost pure p,p'isomer); only 1.3 per cent. of the DDT remained unvaporised at the end of the test, and the mean chemical efficiency was 74.3 per cent. When stored for long periods at the high temperatures encountered in the tropics, both DDT and BHC are liable to release hydrochloric acid, and this inverts the sucrose, producing a liquid in the presence of which it reacts with the potassium chlorate with the result that the mixture eventually ignites. The addition to the DDT mixture of 1 or 2 per cent. magnesium oxide, which reacts with the hydrochloric acid, prevented ignition within 24 hours at 115 and 120°C., temperatures at which mixtures without the magnesium oxide ignited in 83 and 45 minutes, respectively. The higher proportion of magnesium oxide reduced the efficiency of the mixture by 4 per cent., but was included in mixtures for use in the tropics until the effect of protracted storage on mixtures containing 1 per cent. had been tested or less basic oxides proved satisfactory. When technical DDT containing 78 per cent. p,p'isomer was substituted for recrystallised DDT, the mean efficiency was reduced from 70.4 to 65.6 per cent. The use of lactose instead of sucrose reduced the efficiency of compositions containing recrystallised, but not technical, DDT. BHC appeared to be more effective than technical DDT in preliminary tests; a formula of 20 per cent. sucrose, 20 per cent. potassium chlorate, 58 per cent. BHC and 2 per cent. magnesium oxide was temporarily adopted for this material.

The results of tests of the effect of the smokes on insects are very briefly indicated. They should be of particular value for inaccessible sites such as lofts, the holds of ships, thatched roofs and jungle undergrowth, and may provide a quick and labour-saving method for the general disinfection of houses, warehouses, and similar buildings. Both DDT and BHC smokes gave immediate mortality of flies, mosquitos and other insects in houses and farm buildings, and the numbers of house-flies [*Musca domestica*, L.] and cockroaches were greatly reduced for 2-3 months in treated kitchens. In preliminary tests, BHC was more effective than DDT against mosquitos in jungle, and both have since been reported to be effective against tsetse flies [*Glossina*]. The generators function under water, and can be used to produce larvicidal films on pools in which mosquitos breed; DDT and BHC were shown to be equally effective for this purpose. In a test against *Anobium punctatum*, Deg., in the rafters of a church, the deposition of powdered wood ceased after application of the smoke.

GABALDON (A.) & COVA-GARCÍA (P.). **Zoogeografía de los anofelinos en Venezuela : II. Los vectores secundarios y los no vectores.** [Zoogeography of Anophelines in Venezuela. II. The secondary Vectors and Non-vectors.]—*Tijeret. sobre Malar.* **10** no. 2 pp. 78-127, 25 figs. Maracay, 1946.

In this second part of a paper on the distribution of Anophelines in Venezuela [cf. *R.A.E.*, B **36** 54], lists and maps are given showing the localities in which the species other than the two principal vectors of malaria [*loc. cit.*] have been found. They comprise 26 species of *Anopheles* and *Chagasia bathanus*, Dyar.

BATES (M.) & ROCA-GARCÍA (M.). **The Development of the Virus of Yellow Fever in *Haemagogus* Mosquitoes.**—*Amer. J. trop. Med.* **26** no. 5 pp. 585–605, 3 figs., 15 refs. Baltimore, Md., 1946.

The following is largely based on the authors' summary. The effect of temperature on the development of yellow-fever virus in the form of *Haemagogus spegazzinii*, Brèth., that occurs in the area of Villavicencio, Colombia [falco, Kumm, Osorno & Boshell (*cf. R.A.E.*, B **37** 26)] and was referred to in previous work as *H. capricorni*, Lutz [**36** 113; **37** 214] was studied by the inoculation of suspensions of individual mosquitos at regular intervals after the infective meal into groups of mice and by the titration of pools of mosquitos. It was found that there was an initial period during which the content of virus in the mosquito fell, followed by a period during which it rose [*cf.* **26** 139]; the period of loss being five days at 20°C. [68°F.], 3–4 days at 25°C. [77°F.] and two days at 30°C. [86°F.]. At 20°C., the level of virus seemed to remain stable after the period of loss, there being no demonstrable increase in 22 days. At higher temperatures, the rate of gain seemed to be a direct function of the environmental temperature.

The percentage of mosquitos becoming infected and the length of the incubation period seemed also to be a function of the amount of virus ingested with the infective meal. On the basis of the titre of virus in circulation at the time of feeding, the source animals were divided into four arbitrary categories: those having a trace, a small amount and a moderate amount of virus (serum not infecting adult mice in dilutions greater than 1:10, 1:10<sup>3</sup> and 1:10<sup>5</sup>, respectively) and those having a large amount of virus (infections from serum in dilutions of 1:10<sup>6</sup> or more). Virus was in no case recovered from mosquitos that had fed on animals in the first group. It was recovered from occasional individuals fed on animals in the second, from most of those fed on animals in the third and from 90 per cent. or more of those fed on animals of the fourth. The minimum incubation period after the ingestion of a moderate amount of virus was 13 days at 30°C. [*cf.* **36** 113]. Where a large amount of virus was ingested, it was reduced to ten days. There was some evidence that infection at a given temperature and given dosage depended in part on the characteristics of the individual mosquito.

Difficulty was experienced in infecting *Haemagogus* on saimiri monkeys [*Saimiri sciureus caquetensis*] inoculated with pantropic strains of virus modified by serial passage (six consecutive passages) in mice [*cf.* next abstract]. It was not clear whether this was due to the lower titres of virus circulated by such monkeys or to possible modification of the ability of the virus particles to invade mosquito tissue.

In attempts to define the incubation period of the virus in mosquitos by making large numbers of tests with individual females and mice three days old, considerable variation was found among individuals of the same lot, but once a mosquito became infective it remained so for life. The minimum incubation period was found to be 28 days at 25°C., 23 days in mosquitos kept for 20 hours daily at 25°C. and 4 hours daily at 30°C., 12 days with a similar alternation of 25°C. and 35°C. [95°F.], and ten days at a constant temperature of 30°C. Results were unsatisfactory at a constant temperature of 35°C., as mortality was high and mosquitos were reluctant to feed, but no transmissions were obtained in 28 attempts at periods between 5 and 12 days. The very favourable results obtained with mosquitos alternated between 25°C. (for 20 hours) and 35°C. (for 4 hours) suggest that relatively short exposures to high temperatures in nature may greatly accelerate virus development. The same conditions were favourable for adult life and oviposition [**37** 179]. Temperatures of 35°C. do not often occur in the shade at Villavicencio, but *Haemagogus* is a sun-loving

mosquito and there are considerable areas of sunlight in the forest canopy where it abounds.

BATES (M.) & ROCA-GARCÍA (M.). **An Experiment with neurotropic Yellow Fever Virus in Saimiri Monkeys and Haemagogus Mosquitoes.**—*Amer. J. trop. Med.* **26** no. 5 pp. 607–612, 10 refs. Baltimore, Md., 1946.

The following is mainly taken from the authors' summary. A fixed neurotropic strain of yellow-fever virus in its 250th mouse-brain passage was maintained for 22 serial passages in saimiri monkeys [*Saimiri sciureus caquetensis*] by the intramuscular inoculation of a 1 : 10 dilution of the fourth-day serum of the preceding animal. The response of the monkeys to infection, which is described, was similar to that observed in passage experiments with pantropic strains. There was no regular increase in titre of circulating virus in monkeys in successive passages; the strain seemed to lose virulence, since eight of the first nine infections were fatal in contrast with three of the following 13. The incubation period in mice continued short and regular, characteristic of the "fixed" virus.

Eight attempts to infect females of *Haemagogus* [*spegazzinii falco*, Kumm, Osorno & Boshell] on these monkeys failed completely. Virus was not recovered by inoculation of mosquitos into mice or saimiris or by feeding mosquitos on baby mice or saimiris, except in one instance which was probably due to a confusion of mosquitos infected with another strain of virus. These results are compared with those of Davis, Lloyd & Frobisher working on yellow fever and *Aedes aegypti*, L. [*R.A.E.*, B **21** 135] and those of other workers using other possibly neurotropic mosquito-borne viruses.

ANDERSON (C. R.) & OSORNO-MESA (E.). **The Laboratory Transmission of Yellow Fever Virus by Haemagogus splendens.**—*Amer. J. trop. Med.* **26** no. 5 pp. 613–618, 1 fig., 11 refs. Baltimore, Md., 1946.

Experiments are described in which a strain of yellow-fever virus from the Villavicencio area of Colombia was transmitted to *Aotus trivirgatus*, a local species of monkey, by the bite of laboratory-reared females of *Haemagogus splendens*, Will., which occurs elsewhere in Colombia [*R.A.E.*, B **37** 27]. Earlier tests with *Saimiri sciureus caquetensis*, another local monkey, were doubtfully positive. The incubation period of the virus in *H. splendens* was found to be between 14 and 16 days at a constant temperature of 30°C. [86°F.]. The percentage of mosquitos infected was related to the titre of circulating virus of the source animal.

ELMENDORF jr. (J. E.), MARUCCI (P. E.), GRIFFIN (J. B.), MEYER (S. L.) & RYAN (G. S.). **Longevity of killing Effect of DDT for Mosquitoes contacting Screen Wire painted with DDT Solutions.**—*Amer. J. trop. Med.* **26** no. 5 pp. 663–685, 12 figs. Baltimore, Md., 1946.

Most of the work described in this paper concerns the toxicity to mosquitos of screens of copper-wire gauze with 18 meshes to the inch that had been painted with solutions of DDT to leave deposits of 200, 100 or 50 mg. per sq. ft. and stored for different periods indoors or out of doors. Exposure was for four momentary contacts, unless specified otherwise, and the technique used to obtain it is described in an appendix (pp. 683–685). The solvents originally included were acetone, kerosene, diesel oil No. 2, SAE No. 30, SAE No. 50 and heavy mineral oil, but since early experience showed that when the most volatile solvents were used, so that the DDT was left in a dry crystallised state, it very soon lost its capacity to kill mosquitos by four momentary contacts, kerosene and acetone were discarded. Unless otherwise

stated, the test insect was *Anopheles albimanus*, Wied., and weathering was out of doors. The results are given in detail in tables and graphs.

Exposure to screens treated with solvents containing no DDT caused low mortality (up to 25 per cent.) that decreased or disappeared as the deposit grew older. Mortality after exposure generally rose with an increase in observation period from five to 24 hours. Diesel oil was the only solvent in which 200 mg. DDT per sq. ft. gave complete mortality in five hours on the first day after painting, but the same dosage of DDT in SAE 30 gave complete mortality within 24 hours. The solution in diesel oil lost its toxicity very much more rapidly than the other three solutions, and the solution in SAE 50 was the most lasting. DDT at 200 mg. per sq. ft. in SAE 50 and mineral oil effected 65 per cent. kill within 24 hours of exposure after weathering for 29 days. In SAE 50, it gave 10 per cent. kill after 64 days. The same concentration in diesel oil gave only 40 per cent. kill after eight days and 5 per cent. after 22 days, though exposure on the latter occasion was for 30 seconds.

With a few exceptions, mostly of a minor character, the larger dosages of DDT were more toxic than the smaller, irrespective of the solvent or the duration of the observation period. In one test with 100 mg. DDT per sq. ft. in diesel oil, the screens retained their toxicity much longer when stored inside buildings than when exposed out of doors. The killing capacity of a screen stored for 36 days indoors was almost the same as that of one weathered for only eight days outside.

As four momentary contacts with dry crystalline DDT were not enough to cause death, experiments on the exposure necessary were made with *Aedes aegypti*, L. Groups of 20 were placed in test-tubes in which DDT crystals had been uniformly distributed at about 200 mg. per sq. ft. and allowed to rest on the treated surface for two, five or ten minutes. All of those exposed for the two longer periods were dead two hours after removal from the tubes. Of those exposed for two minutes, 65 per cent. were dead after 16 hours, and no more died within 72 hours. There was no mortality in 72 hours among controls. In an experiment in which adults of *Anopheles albimanus* were kept in a treated screen cage measuring 6×6×6 ins., knockdown began 17 minutes after exposure, 70 per cent. were down after 22 minutes and all after 27 minutes.

Tests showed that the crystalline DDT deposited from solutions could be reactivated by re-dissolving the crystals. A screen painted with 5 per cent. DDT in kerosene at 200 mg. per sq. ft. showed no toxicity on four momentary contacts after storage indoors for eight days, whereas a similar screen re-treated with kerosene gave complete kill within two hours of four momentary exposures 24 hours after reactivation. After 48 and 96 hours, screens reactivated with a mixture of kerosene and diesel oil were much more toxic than those activated with kerosene only. On the fifth day, screens reactivated with kerosene alone were practically non-toxic. Screens weathered outside for 29 days after being treated with DDT in diesel oil at 100 mg. per sq. ft. and then reactivated with diesel oil were about as toxic with an exposure of four momentary contacts as they had been before reactivation with contact for 60 seconds. With a deposit of 200 mg., and diesel oil as the solvent, screens were about as toxic on four momentary contacts seven days after reactivation as they had been on contact for 60 seconds before reactivation.

In 26 tests each made with 20 females of *Aedes aegypti* exposed for four momentary contacts to screens to which DDT had been applied less than 24 hours earlier at 200 mg. per sq. ft. in diesel oil, and nine control observations involving 20 females each, the percentages of mosquitos biting were 97·7 in the controls and 70·8, 50·4 and 38·8 in batches exposed to the DDT 10, 20 and 30 minutes earlier. Those becoming engorged practically equalled the number biting, but the time required to engorge increased progressively with the time elapsing after exposure. Although the mosquitos used were *Aedes*,

it is presumed that this indicates that Anophelines could transmit malaria after four momentary contacts with DDT at 200 mg. per sq. ft. However, the four-contact standard is very severe; females of domestic species of *Anopheles* in search of a meal of human blood would presumably rest for a considerable time on treated surfaces.

NEWTON (W. L.) & PRATT (I.). **Experiments to determine potential Mosquito Vectors of *Wuchereria bancrofti* in the continental United States. Part 2.**—*Amer. J. trop. Med.* **26** no. 5 pp. 699–706, 4 refs. Baltimore, Md., 1946.

In continued studies on the ability of mosquitos in the United States to act as vectors of the nocturnally periodic strain of *Filaria (Wuchereria) bancrofti* [cf. *R.A.E.*, B **36** 115], carried out between October 1944 and October 1945 by the same methods as before, 1,314 mosquitos of 14 species were dissected. Notes are given on the distribution and prevalence in the United States and the feeding habits in captivity of the nine species not included in the previous report. *Culex restuans*, Theo., again refused to feed, as did the few females of *Orthopodomyia* sp. tested. Of 108 females of *C. pipiens*, L., examined 9½ days or more after infection, 84 contained infective larvae, 64 having them in the head or proboscis, and 14 more contained larvae in late stages of development. A total infectibility rate of 91 per cent. was obtained with this species. Of 120 females of *Psorophora discolor*, Coq., also dissected late, 38 contained infective larvae, 19 having them in the head or proboscis, and an additional 42 contained larvae in late stages of development. The infectibility rate of this species was 67 per cent. Development of the larvae to advanced or infective stages was occasionally observed in *C. salinarius*, Coq., *Aedes thibaulti*, D. & K., and *Anopheles crucians*, Wied., which had infectibility rates of about 3, 3 and 2 per cent., respectively. Larvae developed normally up to the sausage stage in many examples of *A. crucians*. No development beyond the first stage was observed in *A. quadrimaculatus*, Say, *A. maculipennis freeborni*, Aitken, or *Psorophora ciliata*, F. Adequate numbers of fed females of *Aedes canadensis*, Theo., *C. erraticus*, D. & K., *Mansonia perturbans*, Wlk., and *P. cyanescens*, Coq., were not available, but on the basis of dissection of some 50 individuals of each species more than 9½ days old, none was a good intermediate host except *C. erraticus*. Larvae developed to the late and infective stages in 14 of 49 females of this species, and four had infections of the head or proboscis. The very few females of *P. ferox*, Humboldt, and *P. howardi*, Coq., dissected were negative, but the numbers were too small for any inference to be drawn.

It is concluded that *C. pipiens* and *P. discolor* could serve as vectors of *F. bancrofti*, should conditions be suitable for the spread of filariasis in the United States. As the former is domestic in breeding habits, it would probably play the greater part. *C. erraticus*, which rests in houses and barns during the day, might also be involved to some extent. It is unlikely that *C. salinarius*, *A. thibaulti* or *Anopheles crucians* could act as more than an occasional vector. *A. quadrimaculatus*, *A. maculipennis freeborni* and *P. ciliata* are evidently unable to transmit the infection, and although studies on *Aedes canadensis*, *M. perturbans* and *P. cyanescens* are not completed, it appears that none of these could serve as a vector.

NELSON (E. C.), WEBB (J. E.), BAYLISS (M.) & STARKEY (G. S.). **Studies of Filariasis. Development of *Wuchereria bancrofti* in *Culex quinquefasciatus* of Oahu.**—*Amer. J. trop. Med.* **26** no. 5 pp. 707–713, 15 figs., 3 refs. Baltimore, Md., 1946.

The western Pacific type of *Filaria (Wuchereria) bancrofti*, which is present on Okinawa, is transmitted by *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and appears to develop best in that species, which is the commonest mosquito

on Oahu in the Territory of Hawaii. It was desired to determine whether *F. bancrofti* from Okinawa would develop in *C. fatigans* of Oahu. Samoans infected with *F. bancrofti* had gone to Oahu in the past without any evidence of transmission on the island ensuing, but *F. bancrofti* from Samoa is known to develop best in *Aedes pseudoscutellaris*, Theo. [cf. *R.A.E.*, B 34 38] which is absent from Oahu. From thick blood films taken at night, it was found that 18.7 and 1 per cent., respectively, of 3,768 Okinawan and 659 Japanese prisoners of war on Oahu were positive for *F. bancrofti* and 8.5 per cent. of 570 Koreans for *F. (W.) malayi*. There was strong nocturnal periodicity in both species. When laboratory-reared females of *C. fatigans* were fed on Okinawans positive for microfilariae, development to the infective stage readily occurred. The stages of the filarial larvae in the mosquito are illustrated. Of 14 laboratory-reared females of *C. fatigans* dissected 2–10 days after feeding on a Korean positive for *F. malayi*, only one dissected on the second day contained any larvae.

LAIRD (M.). **Observations on *Anopheles punctulatus* Dönitz, 1901, and *Anopheles farauti* Laveran, 1902, at Palmalmal and Manginuna, New Britain, during July and August, 1945.**—*Trans. roy. Soc. N. Z.* 76 pt. 2 pp. 148–157, 2 graphs, 11 refs. Wellington, N. Z., 1946.

The observations described were begun in the middle of 1945 during military construction work around Palmalmal on the southern shore of Jacquinot Bay, New Britain. Permanent pools with a balanced fauna and flora already existed in the lower areas, and temporary man-made rain pools were being added. The temporary pools without vegetation formed 90 per cent. of the observed breeding places of *Anopheles punctulatus*, Dön. [cf. *R.A.E.*, B 37 52] and only 16 per cent. of those of *A. farauti*, Lav., which preferred pools with shade and shelter provided by algae and emergent and overhanging grasses. Both species bred in greatest abundance near two coastal villages where the blood of seven children examined was positive for malaria parasites. *Plasmodium vivax*, *P. falciparum* and *P. malariae* were all present, and there were several mixed infections. Of blood smears from native children at a hospital at one of these villages but not representative of the coastal population, 33 per cent. were positive. The villages were within half a mile of the outskirts of an air-force station, but the dense rain forest that covered the intervening rising ground was at first believed to provide an effective barrier to Anophelines. However, after several men from this part of the station had developed malaria and adults of *A. punctulatus* and *A. farauti* with very worn wings had been found there, pools near the coastal villages were sprayed each week with 5 per cent. DDT in oil. Only three cases of malaria were reported from the air station in the following months. It is thought that the mosquitos were blown by the strong evening breezes away from the source of blood-meals immediately available on the coast over or through the forest to the air station.

A typical breeding place of each species was studied in detail in July and August to determine the environmental factors influencing development. The water in both pools was usually quite clear and they differed little in hydrogen-ion content, but the temporary pool was subject to a greater range of temperature. At the height of the day, the temporary pool was considerably warmer than the permanent one and warmer than the air, while the permanent one was not; at night, the permanent pool was very slightly warmer than the other, and both were warmer than the air. Larvae of *A. punctulatus* were scarce in the temporary pool during periods in which it was flushed by heavy showers, but became abundant during dry spells following heavy rain. As the period from egg to adult was 6.5–9 days, populations rose to their maximum from one week after the last heavy fall of rain. Smaller pools nearby sometimes

dried up before the adults had emerged. Rainfall had not nearly so marked an effect on the numbers of *A. farauti* in the permanent pool, which remained fairly constant throughout. Predacious insects undoubtedly exercised significant control. The immature stages of *A. farauti* lasted 9–14 days in the laboratory, the larval stage averaging ten days and the pupal stage  $1\frac{1}{2}$  days.

If *A. punctulatus* breeds unchecked in man-made pools near populations that cannot take adequate measures for personal protection, a local increase in the incidence of malaria such as occurred among Australian troops during the campaign at Milne Bay, Papua, will result.

LAIRD (M.). **A Ceratopogonine Midge (*Culicoides anophelis* Edwards, 1922) sucking engorged Blood from a Mosquito (*Armigeres lacuum* Edwards, 1922) at Palmalmal, New Britain.**—*Trans. roy. Soc. N.Z.* **76** pt. 2 pp. 158–161, 1 fig., 15 refs. Wellington, N.Z., 1946.

A female of *Culicoides anophelis*, Edw., with its mouth-parts penetrating the abdomen of an engorged female of *Armigeres lacuum*, Edw., taken in flight was found at Palmalmal, New Britain, in 1945. The abdomen of the Ceratopogonid was distended and reddish, suggesting that it was engorging on blood ingested by the mosquito and not on its body fluids [*cf. R.A.E.*, B **10** 208]. There are very few records of Ceratopogonids attacking unengorged mosquitos or of *Culicoides* attacking non-Anophelines. *C. anophelis* has not previously been recorded from the Australian region.

ROBERTSON (P. L.). **Tyroglyphid Mites in Stored Products in New Zealand.**—*Trans. roy. Soc. N.Z.* **76** pt. 2 pp. 185–207, 12 pls., 1 graph, 45 refs. Wellington, N.Z., 1946.

In the course of this work, which is noticed elsewhere [*R.A.E.*, A **37** 448], it is stated that several cases of dermatitis have occurred in New Zealand among workers handling vells infested by *Glycyphagus domesticus*, Deg., and instances among workers handling stored wool infested by a species of *Tyrophagus* referred to as *T. longior*, Gerv., were noted in 1945.

PUJATTI (D.). **Dermatite vescicobollosa stagionale da *Paederus melampus* Er. (Coleoptera-Staphylinidae) nel sud India.** [Seasonal vesicular Dermatitis caused by *P. melampus* in South India.]—*Mem. Soc. ent. ital.* **26** pp. 5–11, 2 figs., 32 refs. Genoa, 1947.

The author gives a list of species of *Paederus* recorded as causing vesicular dermatitis in man, and states that during a period of service of nearly two years (May 1941 to December 1942) in a prisoner-of-war hospital and adjacent camps near Bangalore, he observed 42 cases due to contact with *P. melampus*, Erichs., which has not previously been reported to cause dermatitis. The adults, which are described, leave their preferred habitats near water during the rains and can then be found in houses, barracks and tents; they are attracted to light. Most cases occurred in May–July. The symptoms are described.

GHIDINI (G. M.). **Disinfestazione con D.D.T. da *Sarcoptes mutans* C. Rob.** [Control of *Cnemidocoptes mutans* with DDT.]—*Mem. Soc. ent. ital.* **26** fasc. suppl. pp. 70–71, 4 refs. Genoa, 1947.

Fowls in Italy, especially those kept under unhygienic conditions, are frequently infested by *Cnemidocoptes* (*Sarcoptes*) *mutans*, Rob. & Lanq., the preferred site of which is beneath the scales of the tarsi. Infestation spreads rapidly through a flock, so that control measures should be promptly applied.

In a test by the author, six hens were completely freed from infestation by brushing the tarsi with 5 per cent. DDT in kerosene ; a second application after three days was necessary in three cases. After treatment, the tarsi were rubbed with olive oil. No harmful effects were observed, the crusts disappeared rapidly, and reinfestation did not occur for a period of 90 days during which the birds were kept clean and roosted apart from the other fowls.

PESSÔA (S. B.). **Parasitologia médica.** [Medical Parasitology.]—2nd revd. edn.,  $9\frac{1}{2} \times 6\frac{1}{2}$  ins., [14+] 997 pp., 2 col. pls., 410 figs., 4 fldg. tables, many refs. São Paulo, Editora Renascença S.A., 1949.

This revised edition of a textbook already noticed is similar in scope to the first [*R.A.E.*, B 36 73], but has been enlarged by the inclusion of a section on spirochaetes, as well as further information on the use of DDT for the control of adult Anophelines and a note on repellents effective against them.

HILL (D. L.), BELL (V. A.) & CHADWICK (L. E.). **Rearing of the Blowfly, *Phormia regina* Meigen, on a sterile synthetic Diet.**—*Ann. ent. Soc. Amer.* 40 no. 2 pp. 213–216, 6 refs. Columbus, Ohio, 1947.

Details are given of a method of rearing *Phormia regina*, Mg., under sterile conditions to provide uniform adults for insecticide tests. The larvae are kept in milk bottles in a medium including powdered casein, brewers' yeast powder and powdered agar in the proportion of 30 : 3 : 1 and small amounts of lanolin and various salts in solution. The eggs are transferred to the medium from meat, having first been sterilised, and the bottle is closed with a sterile cotton-wool plug. When moisture becomes excessive, the plug is removed, and autoclaved sawdust is poured on to the medium until the bottle is almost full. If the larvae exhaust their food supply before they are fully grown, they are transferred to another jar of medium and covered with fresh sawdust. If some of the medium is left when the larvae reach maturity, the sawdust will be wet and pupation in it irregular, so that it is advisable to transfer them to a shallow pan containing a thin layer of sawdust and from which they cannot escape. For emergence of adults, pupae are placed in cups in jars of 1 U.S. quart capacity laid on their sides and covered with wire gauze. Sugar solution is supplied. Flies obtained by this method were 20–25 per cent. heavier than those obtained from contaminated meat and were more uniform in response to treatment with insecticides. Development from egg to adult lasted 15–16 days at 25°C. [77°F.] and 70 per cent. relative humidity.

SNIPES (B. T.), COOPER (R. S.) & CLARK (S. W.). **Comparative Effectiveness of Variations in Spray Pressure, Rotenone Concentration, Sulfur Content, Diluents and Application Methods in Cattle Grub Control.**—*J. econ. Ent.* 41 no. 4 pp. 635–642, 12 refs. Menasha, Wis., 1948.

The following is substantially the authors' summary. In view of diversity in the formulae and methods of application recommended for the use of rotenone preparations in the control of *Hypoderma* spp. on cattle, comparative tests were carried out in Wyoming in March, 1944, to evaluate differences in effectiveness arising from differences in method of application (spray, wash or dust), spraying pressure, rotenone concentration or dust diluents and from the presence or absence of wettable sulphur in liquid preparations. Treatments were applied to 230 infested yearling cattle, and extractions were made 14 days after treatment from five representative animals in each experimental lot. There were 21 different applications and 1,417 dead and living larvae were extracted from

121 treated animals. All instars of both *H. lineatum*, Vill., and *H. bovis*, Deg., were represented in the backs of test animals, but there was no apparent correlation between mortality and species or stage of larval development.

When a standard spray suspension of 5 lb. cubé powder containing 5 per cent. rotenone and 10 lb. wettable sulphur in 100 U.S. gals. water (0.031 per cent. rotenone and 0.082 per cent. total extractives in the suspension) [R.A.E., B 34 166] was applied at 2 U.S. quarts per animal with a power sprayer, mortality rose with increased pressure from 73.1 per cent. with a pressure of 200 lb. per sq. in. to 97.5 per cent. with a pressure of 400 lb. With a constant wettable sulphur content of 10 lb. per 100 U.S. gals. and a pressure of 400 lb., mortalities increased with an increase in the rotenone content of the spray, suspensions containing 0.031 and 0.024 per cent. rotenone giving 97.5 and 75.6 per cent. kill, respectively. Omission of the sulphur from the suspension containing 0.031 per cent. rotenone reduced the percentage kill to 79.5. Suspensions of rotenone powder and wettable sulphur of a given concentration were more effective as power sprays at 2 U.S. quarts per animal than as hand washes scrubbed into the back at 1 U.S. pint per animal.

Cubé dusts applied by hand at 3 oz. per animal were less effective than were power sprays. Those containing 1 per cent. rotenone gave about 50 per cent. kill and those containing 1.25 per cent. somewhat more. Higher concentrations [cf. 36 125] were not tested. There was no apparent significant difference between dusting sulphur, wettable sulphur, pyrophyllite, pumice and double ground tripoli earth as diluents for dusts for hand treatment, although kill was somewhat higher with tripoli earth than with the others.

For convenient and efficient treatment of medium-sized or large herds, power spraying at a minimum pump pressure of 400 lb. with a suspension of 5 lb. rotenone powder (5 per cent. rotenone), 10 lb. wettable sulphur and 100 U.S. gals. water applied at about 2 U.S. quarts per animal is recommended.

BUSHLAND (R. C.), WELLS (R. W.) & RADELEFF (R. D.). **Effect on Livestock of Sprays and Dips containing new Chlorinated Insecticides.**—*J. econ. Ent.* 41 no. 4 pp. 642–645, 1 ref. Menasha, Wis., 1948.

Accounts are given of experiments carried out in Texas in the spring of 1947 and the following November and December in which the toxicity of chlorinated compounds to domestic animals was examined by applying them at a concentration of 1.5 per cent. (by weight) of technical material as sprays to cattle and pigs, as dips to sheep and goats and by sponging to horses. Whatever the method used, the animals were wetted to the skin. They received eight treatments at intervals of four days, and were observed for a further 30 days. This constituted a very severe test. The insecticides used were DDT, 2,2-bis(p-chlorophenyl)-1,1-dichlorethane [DDD], methoxy-DDT, benzene hexachloride [BHC], chlorinated camphene [toxaphene] and chlordan. Emulsion concentrates of all were used and wettable powders of all except DDD and methoxy-DDT. The BHC contained 10 or 12 per cent.  $\gamma$  isomer.

No apparent injury was noted from treatment with DDT, methoxy-DDT, DDD, BHC or toxaphene. In the spring tests with chlordan, sheep and goats dipped in emulsions and suspensions died, and though cattle and horses showed no visible injury, chlordan killed one of two cattle treated with the wettable powder and one treated with the emulsion, as well as some sheep, in a similar test by R. L. Cuff. In the tests in November and December, chlordan of different manufacture was used in emulsions and suspensions on sheep and pigs without causing injury. It was thought possible that the toxicity of the material used in the first series of tests might have been due to its decomposition in storage. In part of a field test by O. H. Graham in January, however, in which ten cattle

were sprayed at fortnightly intervals with a 2 per cent. suspension of the wettable powder used in the second series, two heifers and a cow died 10–12 days after the fourth application, all from chlordan poisoning.

Xylene was the solvent for all the insecticides used in emulsified solution in the second series of tests, and sheep, cattle and horses were temporarily affected by it, though goats and pigs were not. The concentration in the dips and sprays was 3·6 per cent.

In field tests made by W. C. McDuffie in the same locality, a  $\gamma$  BHC wettable powder, applied once as a spray to groups of three cows, caused no injury at 0·25 per cent., killed one and affected another at 0·75 per cent. and killed all three at 1·5 per cent. Using 0·5 per cent.  $\gamma$  BHC, G. W. Eddy and Graham dipped sheep that were in long fleece, five in a suspension and five in an emulsion. Nine of the sheep appeared unaffected, but one died 107 days after being dipped in the emulsion and treated seven days later with a dressing of a paste containing about 2 gm.  $\gamma$  BHC on a small wound infested with screw-worms [*Callitroga hominivorax*, Coq.]. In other field tests, no injury was caused to sheep dipped in 2·5 per cent. technical BHC or 2·5 per cent. toxaphene, cattle sprayed eight times with 2 per cent. suspensions of wettable powders of DDT, DDD, technical BHC, methoxy-DDT or toxaphene, dairy cows treated four times during the summer with chlordan as a 0·5 per cent. suspension, or sheep dipped in a suspension of 2·5 per cent. chlordan.

GINSBURG (J. M.). **Toxicity of Parathion to Mosquitoes.**—*J. econ. Ent.* **41** no. 4 pp. 649–650, 1 ref. Menasha, Wis., 1948.

In the laboratory tests described, the amounts of parathion needed to give 50 per cent. kill of third-instar larvae of *Aedes aegypti*, L., in 48 hours and of pupae in 24 hours were 0·003 and 0·25 parts per million, respectively, when applied as a colloidal dilution prepared by stirring 1 cc. of ethyl alcohol containing the parathion into 200 cc. distilled water, 0·0025 and 0·06 lb. per acre when applied to the surface in an emulsified oil solution, and 0·001 and 0·1 lb. per acre when applied to the surface in pyrophyllite. Complete mortality of larvae occurred with 0·005 p.p.m. parathion dispersed in the water and about 0·005 lb. per acre applied to the surface in emulsion or dust. Complete kill of pupae resulted from the use of 1 p.p.m. in the colloidal dilution and about 0·2 lb. per acre in emulsion. The highest mortality of pupae following an application of dust was 80 per cent. with 0·5 lb. parathion per acre. Comparison with figures for DDT obtained in earlier tests indicated that parathion is several times as toxic, but further work will be necessary before its usefulness in mosquito control can be evaluated.

N[E]ISWANDER (R. E. [*i.e.* R. B.]) & DAVIDSON (R. H.). **A Comparison of the Toxicity of some new Insecticides to the German Roach.**—*J. econ. Ent.* **41** no. 4 pp. 652–653, 3 refs. Menasha, Wis., 1948.

The toxicity to females of *Blattella germanica*, L., of BHC (benzene hexachloride), DDT, chlordan and sodium fluoride was compared, using a dust-tower apparatus. Tests were made by placing the cockroaches in a dusted container and by dusting them and then transferring them to a clean container. When the cockroaches were dusted, BHC diluted to contain 0·5 per cent.  $\gamma$  isomer and applied at 1 mmg.  $\gamma$  isomer per sq. cm. gave 92·5 per cent. mortality and 5 per cent. chlordan, 10 per cent. DDT and undiluted sodium fluoride at 3, 25 and 223·2 mmg. active ingredient per sq. cm. gave 87, 90 and 70 per cent. mortality. When the container was dusted, BHC diluted to contain 0·1 per cent.  $\gamma$  isomer and applied at 0·5 mmg.  $\gamma$  isomer per sq. cm.

gave 98.7 per cent. mortality, and 0.5 per cent. chlordan, 0.5 per cent. DDT and sodium fluoride at 0.75, 3 and 50 mmg. active ingredient per sq. cm. gave 90, 74.4 and 95 per cent. kill, respectively. There was no mortality in the controls. Although BHC was the most toxic compound in all tests, its use is not generally recommended because of its objectionable and persistent odour. It was not determined to what extent fumigant action was involved in its toxicity [cf. *R.A.E.*, B 37 207], but in view of the low deposit of active ingredient, it seems likely that action either as a stomach poison or contact poison was more important. The data showed that application of the insecticides to the cockroaches themselves is unnecessary and that high kills could be obtained with lower dosages if the places where they hide or run were treated.

FAY (R. W.), SIMMONS (S. W.) & CLAPP (J. M.). **Extended Laboratory Investigations on the Toxicity of DDT Residues to Adults of *Anopheles quadrimaculatus*.**—*Publ. Hlth Rep.* 62 no. 5 pp. 149–158, 8 graphs, 3 refs. Washington, D.C., 1947.

In laboratory tests of the effect of prolonged ageing on the toxicity to *Anopheles quadrimaculatus*, Say, of the deposits from DDT sprays, batches of at least 20 laboratory-reared females 3–4 days old were exposed in a chamber consisting of a wooden framework into which four treated panels were fitted to give a total treated surface of 1 sq. ft. on the sides, with an untreated surface of  $\frac{1}{2}$  sq. ft. on the ends [cf. *R.A.E.*, B 35 14]. The untreated surfaces were such that they could be adequately cleaned or renewed to prevent cumulative contamination. The chamber was darkened during exposure. Afterwards, the mosquitos were transferred to an observation cage; knockdown was recorded immediately and mortality after 24 and 48 hours. The formulae used for calculating kill and smoothing graphs are given.

To investigate further the relationship between exposure time and mortality, the panels were sprayed with emulsified xylene solution to give deposits of 50, 100, 200 and 300 mg. DDT per sq. ft., and the mosquitos were exposed for periods varying from two minutes to four hours at intervals of up to 68 weeks after treatment. The combined average mortalities after 48 hours caused by the four dosages with exposures of 35–180 minutes are shown in tables and graphs and examined statistically. The four deposits gave comparable results for the first 12 weeks, but after this, the mortalities they caused diverged more. During the first six months, there was more loss of effectiveness with a shorter exposure period than with a longer one. From an analysis of the mean results for 60-minute exposures to the four deposits, it appeared that effectiveness deteriorated for about 16 weeks and then remained approximately constant for the next six months, after which it fell rapidly. This may indicate that more than one factor is important in the deterioration of the deposits. It is suggested that the levelling might be the sequel to the removal of most of the surface deposit, which would be the most susceptible to flaking [cf. 34 189]. A graph is given showing that the slope of the curve representing the relation between percentage mortality and exposure period gradually decreases as the age of the deposit increases.

In another test, average mortalities 48 hours after exposure of adults for one hour to deposits of 100 and 200 mg. DDT per sq. ft. at various times  $\frac{1}{2}$ –84 weeks after application were compared. The effectiveness of both deposits deteriorated fairly rapidly over the first 30 weeks and more slowly for the next 40 weeks. The heavier deposit was appreciably the more effective, being about equal after 16 weeks to the lighter one after 12 weeks. Knockdown rates after one hour were good indications of relative toxicity. Further investigations on

deposits ranging from 25 to 400 mg. DDT per sq. ft. confirmed previous observations [35 14-15] that deposits of less than 100 mg. were less lasting than heavier ones, but deposits of more than 200 mg. were not sufficiently better than lighter ones to be economically justified.

In further tests, panels were sprayed with DDT in emulsions prepared with five different solvents to give a deposit of 200 mg. DDT per sq. ft., and mosquitos exposed to them for 30 minutes at intervals over a period of at least six months. DDT in xylene lost effectiveness more rapidly during the first 12 weeks than during the following 48 weeks. The trend was similar with Solvesso No. 2, which resembled xylene in its solvent properties and evaporation rate. DDT in kerosene, PD-544C [35 14] and Velsicol AR-50 (a methylated naphthalene solvent), which volatilise more slowly, did not show so marked a loss of effectiveness during the first 12 weeks. DDT in xylene and Solvesso No. 2 gave white crystalline deposits on blue enamelled surfaces, whereas in kerosene and Velsicol AR-50 it did not give appreciable visible deposits. In view of these observations, it is concluded that the solvent used may influence the type of initial deposits, which may in turn influence the duration of effectiveness. If initial loss of effectiveness is due to flaking, the effect of the solvent may be due to its influence on the adherence of the crystals to the surface. While a deposit of 100 mg. DDT per sq. ft. showed appreciable loss of toxicity over a period of 42 weeks to females of *A. quadrimaculatus* exposed for 30 minutes, there was little loss of toxicity to males.

CLAPP (J. M.), FAY (R. W.) & SIMMONS (S. W.). **The comparative residual Toxicity of DDT to *Anopheles quadrimaculatus* when applied on different Surfaces.**—*Publ. Hlth Rep.* 62 no. 5 pp. 158-170, 6 graphs, 2 refs. Washington, D.C., 1947.

In the experiments recorded, females of *Anopheles quadrimaculatus*, Say, were exposed to deposits of DDT on surfaces of the types that occur in houses by means of a technique previously described [see preceding abstract]. Natural conditions were simulated as far as possible, the subsurface material and drying time being taken into account. The following is based on the authors' summary of the results. The type of surface affected the persistence of the toxicity of spray deposits, deposits on rough wood, fabrics, wallpaper, well-dried paints and rubbing varnish possessing the most lasting toxicity. DDT was not effective under the conditions of the test on whitewash, fresh paints, spar varnish, linoleum or simulated adobe. Results were worst with the last two, and even applications of 600 mg. DDT per sq. ft. were ineffective on adobe.

DDT sprays did not damage plastic screen or fabrics composed of plant or animal fibres and caused no visible damage to linoleum or flat paint surfaces. If applied too heavily, they caused some clouding of high-gloss enamels, some staining of wallpaper and persistent discoloration of spar varnish. Sprays of DDT in kerosene or emulsified Velsicol AR-50 (Special), had less deleterious effects on dark-gloss enamels than emulsions prepared with xylene.

The nature of the surface affected the final distribution of the DDT deposits. Fabrics, wallpaper and rough wood tended to hold the crystals on the surface, whereas plain, smooth wood was penetrated by the spray and much of the deposit remained beneath the surface. Linoleum, fresh paints and varnishes were readily penetrated by the solvents and some of the DDT crystals were thereby permanently or temporarily occluded. The incorporation of salt into whitewash increased the effectiveness of DDT applied to the surface. Deposition of grease or smoke on surfaces previously treated with DDT decreased the effectiveness of the DDT deposits.

BUSVINE (J. R.) & KENNEDY (J. S.). **Experiments with Insecticidal Smokes for indoor Use.**—*Ann. appl. Biol.* **36** no. 1 pp. 76–85, 1 pl., 2 refs. London, 1949.

Insecticidal smoke generators of the grenade type [cf. *R.A.E.*, B **37**: 226] were tested in the laboratory in November 1945 by the first author and in practice between August and November by the second. The insecticides used were crude DDT and crude BHC (benzene hexachloride), and a generator contained 110 gm. of the former or 120 gm. of the latter. About 60–70 per cent. of the insecticide was emitted unchanged as smoke particles of less than  $1\mu$  in diameter, generated by a slow combustion mixture. In the laboratory tests, the generators were used at the rate of one to 1,800–2,500 cu. ft. Doors and windows were not sealed but were kept closed for at least an hour, after which much of the smoke had settled or leaked away. Examination under the microscope showed that the particles of DDT deposited were liquid, apparently in a super-cooled condition, for mechanical stimulation caused the formation of needle-like DDT crystals. The BHC deposit consisted of small dendritic growths of crystals. BHC smoke gave 100 and 90 per cent. kill of mosquitos (*Culex*) and bugs (*Cimex lectularius*, L.), respectively, protected by two layers of straw matting, and DDT smoke killed all mosquitos similarly protected but only 8 per cent. of bugs. Evidence was obtained that the BHC deposit was more effective than the DDT against *Cimex* one day after treatment and against mosquitos (*Culex* and *Aedes*) one week after, but DDT was the more effective against the bugs after a month. The effects of deposits of either material on horizontal surfaces were good against bugs, but the deposits on vertical surfaces were not highly effective. Action of deposits against mosquitos on vertical surfaces a week after treatment was fair, but the effect on “inverted” surfaces (the under surfaces of boards, etc.) was poor. The deposits of active insecticide on horizontal, vertical and inverted surfaces were about 15–30, 3–10 and 2–6 mg. per sq. ft., respectively.

The practical trial was made in kitchens infested by flies (*Musca domestica*, L., and a few of *Fannia canicularis*, L.) and cockroaches (*Blattella germanica*, L., and *Blatta orientalis*, L.). The generators were used at the rate of one to about 640 cu. ft. A substantial reduction of flies was obtained for 11 weeks with DDT, but for only two weeks with BHC. DDT and BHC reduced heavy infestations of *Blatta* and *Blattella*, respectively, to negligible proportions for 2–3 months, and there was evidence of some repellent effect. The BHC smoke cleared more rapidly than the DDT, and the deposit from the former was more noticeable than that from the latter, which left only a bloom on polished surfaces. All exposed iron or steel surfaces in the kitchen treated with DDT became markedly oxidised during the night following treatment; this was not noticeable where BHC was used. It was found that very careful precautions to prevent indirect tainting of food or water are needed when smoke generators are used. They are very wasteful of insecticide, especially since two or perhaps three treatments per season might be necessary, and this would use 20 times as much insecticide as a single spray treatment. On the other hand, the cost of labour and equipment is somewhat lower, and operation very much easier.

#### PAPERS NOTICED BY TITLE ONLY.

D'ABRERA (V. St. E.). **Further Observations [in Ceylon] on Cases of Asthma and Bronchitis associated with high Eosinophilia and with Mites in the Sputum.**—*Indian med. Gaz.* **81** no. 10 pp. 414–417, 10 refs. Calcutta, 1946. [Cf. *R.A.E.*, B **36** 200.]

RIEMSCHEIDER (R.). **Zur Kenntnis der Kontakt-Insektizide. Kontakt-Insektizide auf Halogenkohlenwasserstoffbasis.** [Contribution to the Knowledge of Contact Insecticides. Contact Insecticides with a Halogenated Hydrocarbon Basis (mainly review of literature).]—*Pharmazie Beih.* **2** Ergänzungsbd. **1** pp. [2+] 77–97, 64 refs. Berlin, 1947.

RIEMSCHEIDER (R.). **Zur Kenntnis der Kontakt-Insektizide. Konstitution und Wirkung von Insektiziden.** [Contribution to the Knowledge of Contact Insecticides. Relation of Chemical Structure to Effectiveness of Insecticides (including tests of over 120 halogenated hydrocarbons on *Melophagus ovinus*, L.).] **Mitteilung I.** [Communication I.]—*Pharmazie Beih.* **2** Ergänzungsbd. **1** pp. 99–157, 3 figs. Berlin, 1947. **Mitteilung II.**—*T.c.* pp. 159–172, 95 refs.

METCALF (R. L.). **The Mode of Action of organic Insecticides.**—*Rev. chem.-biol. Co-ord. Cent.* no. 1, 84 pp., 6½ pp. refs. Washington, D.C., 1948. [See *R.A.E.*, A **37** 481.]

HEAL (R. E.) & MENUSAN jr. (H.). **A Technique for the Bloodstream Injection of Insects** [*Periplaneta americana*, L.] **and its Application in Tests of certain Insecticides.**—*J. econ. Ent.* **41** no. 4 pp. 535–543, 4 figs., 21 refs. Menasha, Wis., 1948. [See *R.A.E.*, A **37** 459.]

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